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NUCLEAR SCIENCE ABSTRACTS

Volume 20 Number 11

Abstracts 18184–20367

June 15, 1966

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Volume 20, Number 11, June 15, 1966

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A-30

TABLE OF CONTENTS

Volume 20, Number 11, June 15, 1966

Category	Page
BIOLOGY AND MEDICINE	2229
General	2229
Ecology	2231
Metabolism, Tissue Distribution, and Toxicology	2231
Radiation Effects on Biochemicals	2237
Radiation Effects on Tissues	2242
Radiation Effects Therapy and Countermeasures	2260
Radiation Hazards and Protection	2270
Radiotherapy and Radiodiagnosis	2270
CHEMISTRY	2277
General	2277
Analytical Procedures	2277
Inorganic and Physical Chemistry	2285
Organic Chemistry	2295
Radiation Chemistry	2297
Radiochemistry	2307
Separation Processes and Procedures	2309
ENGINEERING	2314
General	2314
Applications of Nuclear Explosions	2314
Facilities and Equipment	2314
Heat Transfer and Fluid Flow	2315
Materials Testing	2318
Space Propulsion	2318
Vacuum Engineering	2319
GEOLOGY, METEOROLOGY, AND MINERALOGY	2320
General	2320
Natural Radioactivity and Fallout	2321
Techniques and Equipment	2323
HEALTH AND SAFETY	2326
INSTRUMENTATION	2332
General	2332
Radiation Detection	2334
Radiation Effects	2342
ISOTOPE TECHNOLOGY	2346
General	2346
Industrial Applications	2346
Power Application	2347
Separation and Production	2347
MATHEMATICS AND COMPUTERS	2352
METALS, CERAMICS, AND OTHER MATERIALS	2353
General	2353
Corrosion	2354
Fabrication	2356
Properties and Structure	2357
Radiation Effects	2363
PHYSICS	2366
General	2366
Accelerators	2367
Astrophysics and Cosmology	2371
Atomic Physics	2375
Cosmic Radiation	2381
Direct Energy Conversion	2382
Elementary Particles and Radiations	2383
Field Theory, Scattering Theory, and Symmetries	2392
Fluid Physics and Thermodynamics	2398
Geophysics	2401
Gravitation, Quantum Mechanics, and Relativity Theory	2409
Low Temperature Physics	2411
Neutron Physics	2416
Nuclear Properties and Reactions	2419
Plasma Physics and Thermonuclear Processes	2437
Shielding	2449
Solid State Physics	2450
REACTOR TECHNOLOGY	2460
General	2460
Auxiliaries and Components	2460
Criticality Studies	2461
Design and Feasibility	2464
Fuels	2464
Power and Power-Breeder Reactors	2465
Process Heat Reactors	2470
Production Reactors	2471
Propulsion and Space	2471
Research and Test Reactors	2473
WASTE DISPOSAL AND PROCESSING	2476
GENERAL AND MISCELLANEOUS	2478
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-12
SUBJECT INDEX	INDEX-60
REPORT NUMBER INDEX	INDEX-156

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Volume 20, Number 11 June 15, 1966

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 18369.

18184 (BNL-929, pp 115-25) BIOLOGY. (Brookhaven National Lab., Upton, N. Y.).

Research activities directed toward animal physiology, genetics, cell physiology, biochemistry, biophysics, and ecology are summarized. (J.R.D.)

18185 (BNL-929, pp 126-47) MEDICAL RESEARCH. (Brookhaven National Lab., Upton, N. Y.).

Medical research is summarized on uses of extracorporeal irradiation of blood, hemopoietic colony-forming cells in mice, radioinduced eye lens opacification, effects of 2.2 Bev protons on mammals, dosimetry using mesons (π^-), epithermal neutron beam dosimetry, use of swine skin in radiation effects evaluation, Sr and Ca metabolism in man, radiosensitivity of antibody responses, and bile effects on gastrointestinal syndrome of dogs. Research results are also reported on bioenergetic mechanisms involving free radicals, properties of hydroxylysine and collagen, inheritance and protein synthesis, physiology of trace metals, insulin protein structure and activity, tracer studies of obesity and diabetes, distribution of insulin in muscle, mechanisms of neurohypophyseal peptide actions, effects of genetics and sodium on hypertension, conversion of glycine-2 ^{14}C to cyanide by chromobacterium, synchronous growth and division in cell cultures, nucleic acid metabolism, skeleton growth and aging, effects of tritiated thymidine incorporation in DNA, studies of fallout-exposed Marshall islanders, blood culture cytology, neutron radiography, Ga neutron capture, ^{99}Tc as a scanning agent, computer uses, and positron scanning. (J.R.D.)

18186 (LA-3432, pp 102-29) BIOPHYSICS SECTION. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

Erythrocyte volume distributions were measured electronically in mice during recovery from γ radiation induced bone marrow arrest and the data were analyzed using a computer. Microscopic data agreed with results given by the electronic sizing procedure. The geometry of the hydrodynamic flow of particles through a Coulter aperture was studied using uniform polystyrene spheres. Design features are described of an electronic particle separator that separates particles according to their volume. Results are reported from tests using polystyrene spheres ranging in diameter from 7 to 14 μ and quantitative separation of human and mouse erythrocytes from a mixture of the two and volume fractions of mouse lymphoma cells growing in suspension culture. The development of a gas-filled proportional counter to measure the soft x rays from ^{239}Pu lung burdens in humans is reported. (C.H.)

18187 (N-65-16497) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Annual Progress Report No. 3. Heim, Allen H. (Resources Research, Inc., Washington, D. C.). Mar. 30, 1964. Contract NASr-10. 170p. (NASA-CR-56214). CFSTI $5.00 cy, $1.00 mn.

Gulliver III, the third model of the instrument designed to detect extraterrestrial life, successfully detected terrestrial microbial life in 12 field tests during the year. Four of the testing sites, specifically selected for their severe, adverse environmental conditions, were Sheep Mountain, in the White Mountain Range of California, which was cold, rocky, barren terrain at an altitude of 12,000 ft; Death Valley, California, which provided an arid, sandy environment; the salt encrusted desert flats of the Salton Sea in California; and Orange, Virginia, with its hard, iron-rich, clay surface. All of these extreme natural environment tests yielded good, positive responses in relatively short time periods. Work is also reported on the culture medium, on test microorganisms and responses, on anaerobic determinations, on other biological subjects, and also on instrumentation. (STAR)

18188 (ORO-635) SEMIANNUAL PROGRESS REPORT ON AGRICULTURAL RESEARCH, JANUARY 1-JUNE 30, 1965. (UT-AEC Agricultural Research Lab., Oak Ridge, Tenn.). Dec. 30, 1965. Contract AT(40-1)-Gen-242. 161p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Progress is reported in studies on the early and late effects of mixed γ and neutron exposure on burros, cattle, sheep, and swine; the physiology of reproduction of cattle, sheep, and rabbits; the analysis of death patterns of irradiated burros, cattle, sheep, and swine; physiological events that occur as a result of whole-body irradiation of rats, sheep, and rabbits; radioinduced tumors in rats; the metabolism of certain fission products and chemically related nuclides in sheep, swine, and cattle; the effect of a single large dose of ^{131}I on performance and iodine metabolism in dairy cows; tracer studies of poultry nutrition, with emphasis on protein metabolism in chickens; the fission product chemistry of soils, with emphasis on studies of properties of mineral clay fractions of soils that affect the availability of fission products to plant roots, in which ^{134}Cs was used as a tracer; and studies on radiation genetics with emphasis on heritable effects of γ or neutron radiations on plant embryos, buds, and pollen, and environmental factors modifying such effects. A list is included of publications during the period covered by this report. (C.H.)

18189 (UCLA-12-576) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1965. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). Contract AT-04-1-GEN-12. 106p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Separate abstracts were prepared on six sections of this report. A list is included of forty publications during the period covered. (C.H.)

For abstracts of individual sections see: 18210 18211, 18295-18297, and 18509.

18190 (UCRL-16613) BIOLOGY AND MEDICINE SEMIANNUAL REPORT, FALL 1965. Lawrence, John H. (ed.) (California Univ., Berkeley. Donner Lab. California Univ., Berkeley. Donner Pavilion. Lawrence Radiation Lab., Univ. of California, Berkeley). Contract W-7405-eng-48. 109p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Progress is reported in diverse radiobiological studies including: estimations of radiation doses astronauts will encounter on the Apollo mission to the moon; the response of Li-drifted silicon detectors to high-energy α and proton beams; a comparison of the biological effects of the π^- beam produced by the 184-in. cyclotron with the effects of the x radiation, γ radiation, and α particles on the production of chromosome aberrations in Vicia faba root meristems; the effect of the negative pion beams on the proliferative capacity of an ascites lymphoma irradiated in mice and assayed in vivo; the isolation of DNA from bacteriophages; the recovery of yeast (Saccharomyces cerevisiae) after exposure to x radiation or heavy ions (^{4}He, ^{12}C, or ^{20}Ne); genetic studies of x and uv induced yeast mutations; the relative magnitude of mutational and balanced components of genetic load in populations; electrophoretic studies of light-induced electrical charge in spinach chloroplasts; the content of erythropoietin in urine of patients with anemia secondary to hookworm; the phagocytic activity of the reticuloendothelial system of mice after suppression of immune responsiveness by neonatal thymectomy or by adult thymectomy plus whole-body γ irradiation; and studies on the ESR spectrum of OH free radicals produced in irradiated H_2O and ice samples in both polycrystalline and single crystal form. A list is included of 24 papers published during the period covered by this report. (C.H.)

18191 ON THE MECHANISM OF URETHAN LEUKEMOGENESIS IN NEWBORN C57BL MICE. I. INFLUENCE OF INJECTIONS OF SYNGENEIC BONE MARROW CELL SUSPENSIONS. Berenblum, I.; Boiato, Louise; Trainin, N. (Weizmann Inst. of Science, Rehovoth, Israel). Cancer Res., 26: 357-60(Mar. 1966).

Intravenous injections of syngeneic bone marrow cell suspension failed to inhibit urethan leukemogenesis in newborn C57BL/6 mice, in contrast to the known inhibition of radiation leukemogenesis by bone marrow in adult mice of the same strain. Other differences in the mode of action between whole-body x-irradiation and urethan are discussed in the light of the present results. (auth)

18192 ON THE MECHANISM OF URETHAN LEUKEMOGENESIS IN NEWBORN C57BL MICE. II. INFLUENCE OF THYMECTOMY AND OF SUBSEQUENT THYMUS REIMPLANTATION. Berenblum, I.; Boiato, Louise, Trainin, N. (Weizmann Inst. of Science, Rehovoth, Israel). Cancer Res., 26: 361-3(Mar. 1966).

Urethan leukemogenesis was found to be fairly potent in C57BL mice when the treatment was begun soon after birth (35% incidence) but very weak when the treatment was begun at about 45 days of age (6% incidence). The inhibitory effect of thymectomy on urethan leukemogenesis was not reversed by subsequent implantation of syngeneic newborn thymus, in contrast to such a reversal in the case of radiation leukemogenesis. Possible reasons for the difference are discussed. (auth)

18193 DIRECT ACTION OF A LEUKEMOGENIC VIRUS ON THE THYMUS. Haran-Ghera, Nechama; Lieberman, Miriam; Kaplan, Henry S. (Stanford Univ., Palo Alto, Calif.). Cancer Res., 26: 438-42(Mar. 1966).

When a leukemogenic virus (radiation leukemia virus, RLV), extracted from radiogenic lymphomas of strain C57BL mice, was directly injected either into 1 lobe of the thymus in situ in newborn C57BL mice, or into intrarenal C57BL thymic grafts in thymectomized, irradiated C57BL or F, hybrid hosts, a high incidence of lymphoid tumors developed after an unusually short latent period. No such tumors resulted when RLV was injected into intrarenal grafts of spleen or lymph node in similarly prepared hosts. In the neonatally inoculated animals, tumors originated invariably in the injected lobe, indicating that there is a direct neoplastic interaction between RLV and target cells in the thymus. Histologic examination and transplantation assays revealed that transformed cells with neoplastic potentialities are present in the thymus grafts as early as one week after virus inoculation. Virus injection into graft-bearing hybrid hosts elicited a high proportion of tumors that exhibited the transplantation behavior characteristic of donor cell derivation. Data on other parameters, such as the route of virus injection, the interval between graft placement and virus injection, and the requirement for systemic or partial-body irradiation are also presented. (auth)

18194 A CLUSTER OF GENES CONTROLLING THREE ENZYMES IN HISTIDINE BIOSYNTHESIS IN SACCHAROMYCES CEREVISIAE. Fink, Gerald R. (Yale Univ., New Haven). Genetics, 53: 445-59(Mar. 1966).

The biochemistry, genetics and complementation of mutations in the hi-4 region of yeast (Saccharomyces cerevisiae) were studied. The hi-4A cistron specifies the information for the third step in histidine biosynthesis, the hi-4B cistron for the second, and the hi-4C for the last. Enzyme assays show that mutants limited to one cistron on the complementation map lack only one enzymatic activity. In addition to these mutants exhibiting localized defects, there are ABC and BC mutants which have lost all three enzymatic activities. These multiply defective mutants behave as partially complementing or completely noncomplementing types and are characterized by a striking polarization of the mutational defect from the left to the right on the complementation map of the hi-4 region. The genetic distribution of the hi-4 alleles was examined by fine-structure analysis both by two-factor and by three-factor crosses. The noncomplementing alleles are not distributed at random throughout the region; rather, all 22 tested are clustered in the A region. Asymmetric localization of the noncomplementing alleles, biochemical heterogeneity, and polarization of the complementation map are characteristics of operons but not of single cistrons. Consistent with the operon interpretation of the hi-4 region is the observation that only the noncomplementing alleles or alleles having polarized defects within hi-4 are suppressible by the amber-like suppressor, S_d. (auth)

18195 GENETIC AND BIOCHEMICAL STUDIES OF GENES CONTROLLING THE SYNTHESIS OF THREONINE AND METHIONINE IN SACCHAROMYCES. de Robichon-Szulmajster, H.; Surdin, Y.; Mortimer, P. K. (CNRS, Gif-sur-Yvette, France. Univ. of California, Berkeley). Genetics, 53: 609-19(Mar. 1966).

Mutants at six loci were identified, two of which require threonine alone, while four require both threonine and methionine. Five of these were mapped and biochemical defects were identified for four loci. An effect of glutamate or lysine on growth of thr_5 strains is probably due to another mutation which manifests itself only under the growth conditions required for thr_5 mutants. (auth)

18196 THE REGULATION OF SYNTHESIS OF LEUCINE BIOSYNTHETIC ENZYMES IN NEUROSPORA. Gross, S. R. (Duke Univ., Durham, N. C.). Proc. Natl. Acad. Sci., 54: 1538-46(Dec. 1965).

Regulation of the four leucine cistrons of Neurospora is discussed. Although the cistrons are distributed randomly throughout the genome, the function of each is regulated in response to specific metabolic demands. Data are presented suggesting that regulation is achieved by a dual mechanism consisting of: repression of synthesis of the first enzyme of the pathway, α-isopropylmalate synthease, by endogenous leucine; and induced synthesis of subsequent enzymes of the pathway by the product of the first reaction α-isopropylmalate. Thus, Neurospora probably makes use of both single and multisignal mechanisms of regulation. (H.G.D.)

18197 INDUCTION OF NEOPLASIA IN VITRO IN HAMSTER KIDNEY TISSUE BY ADENOVIRUS 7-SV40 HYBRID STRAIN (LLE46). Rabson, Alan S.; Malmgren,

Richard A.; Kirschstein, Ruth L. (National Inst. of Health, Bethesda, Md.). Proc. Soc. Exp. Biol. Med., 121: 486-9(Feb. 1966).

Newborn hamster kidney cell cultures were transformed in vitro by LLE46 virus, an adenovirus 7-SV40 hybrid, and by SV40. The cultures transformed by both viruses consisted of rapidly growing cuboidal and polygonal cells, although those in the LLE46 cultures were smaller and had less tendency to grow in clumps. Neither infectious adenovirus 7 nor SV40 could be recovered from the transformed cells. More than 90% of the cells in both the LLE46 and the SV40 cultures contained persistent intranuclear SV40 T antigen while no adenovirus 12 or 7 T antigens were demonstrable. Tumors were rapidly produced when both types of transformed cells were injected into newborn hamsters, and into irradiated young adult hamsters. As previously described, the tumors produced by the SV40 transformed cells were predominantly carcinomas with areas of tubular differentiation. These produced by the LLE46 transformed cells, however, were predominantly undifferentiated and histologically similar to adenovirus 12 tumors. Although they did contain a few small foci resembling SV40 sarcomas, no tubular epithelial structures were seen. (auth)

18198 BIOLOGICAL, MEDICAL, AND ENVIRONMENTAL RESEARCH. pp 105-214 of Fundamental Nuclear Energy Research. Washington, D. C., U. S. Atomic Energy Commission, 1965.

Summaries are presented of research on selected beneficial applications of atomic energy. Information is included on medicine, agriculture, cancer, somatic radiation effects, radiation genetics, environmental radiation studies, health physics, and instrumentation. Information is also included on toxicity of radioelements, and fallout. (J.R.D.)

Ecology

18199 (NYO-3450-1) MARINE GEOCHEMISTRY. Proceedings of a Symposium Held at The University of Rhode Island, October 29 and 30, 1964. Occasional Publication No. 3. Schink, David R.; Corless, James T. (eds.) (Rhode Island Univ., Kingston. Narragansett Marine Lab.). Aug. 1965. Contract AT(30-1)-3450. 371p. (CONF-641026). Dep. mn. CFSTI $7.00 cy, $1.75 mn.

Thirteen articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 18200–18202, 18632, 18633, 18892–18896, 18925, 18926, and 18944.

18200 (NYO-3450-1, pp 109-29) DISTRIBUTION OF GAMMA EMITTING RADIONUCLIDES IN THE GULF OF MEXICO. Slowey, J. Frank; Hayes, David; Dixon, Bryan; Hood, Donald W. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Oceanography and Meteorology).

Data on the concentration, distribution, and chemistry of ^{54}Mn, $^{95}Zr-^{95}Nb$, ^{106}Ru, ^{144}Ce, and ^{125}Sb in the Gulf of Mexico are presented. ^{54}Mn was found present in all water samples examined and in concentration comparable to that of the fission produced isotopes, $^{95}Zr-^{95}Nb$, ^{106}Ru, and ^{144}Ce. The concentration factor of this isotope in Hiatella arctica and green algae was higher than any of the other nuclides examined. Data obtained on particulate Mn indicate that the ^{54}Mn occurs at a higher concentration in the particulate matter than does stable ^{55}Mn. This suggests that the chemical form in which ^{54}Mn reaches the sea is different than that for stable Mn. The results also showed that 50% of the $^{95}Zr-^{95}Nb$, 66% of the ^{106}Ru, and 33% of the ^{144}Ce occurs in the soluble (including colloidal) form even after a period of approximately 18 months following the last nuclear test. ^{125}Sb was found in surface seawater with an average concentration of 14.1 $lm\mu C/l$. No ^{125}Sb was found in organisms or in particulate matter. (P.C.H.)

18201 (NYO-3450-1, pp 149-68) FACTORS AFFECTING THE DISTRIBUTION OF DEUTERIUM IN THE OCEAN. Redfield, Alfred C.; Friedman, Irving (Woods Hole Oceanographic Institution, Mass.).

Since the distribution of salinity and temperature of the oceans is known in great detail, attempts were made to determine the deuterium concentration in samples of water that were identified by these characteristics and have sought correlations that could be applied widely in establishing the pattern of deuterium distribution. The results indicated that the distribution beneath the sea surface depends on the physical processes of mixing and advection of water which has derived its deuterium content at the surface as the result of fractionation by evaporation or freezing and by dilution with runoff or reprecipitation of the evaporate. Subsurface waters vary in deuterium content in proportion to their salinity but in accordance to ratios which differ characteristically in different regions. It was concluded that information may be obtained from deuterium about the exchange of water between the sea surface and the atmosphere which is not given by salinity alone. (P.C.H.)

18202 (NYO-3450-1, pp 185-201) GEOCHEMISTRY OF IODINE, BROMINE, AND CHLORINE IN THE AIR-SEA-SEDIMENT SYSTEM. Winchester, John W.; Duce, Robert A. (Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics).

Air, aerosols, and rain water were analyzed for Cl, Br, and I. All three halogens showed a decrease in concentration in rain samples with increasing altitude. Halogen ratios for aerosols collected by a cascade impactor at landbased stations and at various altitudes showed differences in composition among the size fractions in each collection, and between collections, including collections at the same elevation on different days. From atmospheric results, it is suggested that the variability in the relative abundance of I, Br, and Cl in the atmosphere is real and may be a sensitive indicator of general atmospheric chemical processes in the troposphere. (P.C.H.)

Metabolism, Tissue Distribution, and Toxicology

18203 (LA-3432, pp 21-55) MAMMALIAN METABOLISM SECTION. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

The distribution of ^{54}Mn in rats was measured as part of the programmatic investigation of the retention and distribution of a number of gamma-emitting isotopes. Radiocesium (^{137}Cs) was administered intraperitoneally to 3 groups of mice, each consisting of 8 female RF mice 60 days old and weighing about 25 g. The activity in each mouse was determined in a 4π geometry scintillation detector immediately after administration and at intervals thereafter for about 1 month. During the course of the experiment, the mice were maintained in individual cages where they had free access to water and food. One group was maintained at 35°C (high-temperature animals), one at 7°C (low-temperature animals), and one at 22°C (control animals). At various times during the experiment the oxygen consumption was measured with a commercial spirometer which necessitated the removal of the high- and low-temperature animals from their test environments to room temperature for oxygen consumption measurements. The abnormal temperatures had an immediate effect on retention of cesium-137, but had a questionable effect on oxygen consumption before 2 weeks exposure. However, before and during the oxygen consumption measurements the test animals were at the control temperature and the early absence of effect is attributed to this factor. That is, cesium was excreted for 23.5 hr/day at stress temperatures, whereas oxygen consumption was measured at room temperatures. The later changes in oxygen consumption are attributed to conditioning of the metabolic rates to abnormal temperatures. If this interpretation is valid, then cesium excretion and oxygen consumption are only loosely coupled rather than united in a cause-effect relationship. Ferric ferrocyanide appears to be a non-toxic, insoluble dye that may be useful as a therapeutic agent for cesium-137 contamination. Its

effect is primarily, if not solely, one of binding Cs^+ ions in the lumen of the gut and hence preventing absorption and subsequent recycling of the ion. As a result, more Cs^+ ions are lost via the feces than in normal animals. At the request of the U. S. Atomic Energy Commission's Division of Biology and Medicine in 1962, systematic measurements were made on the secular changes in whole-body cesium-137 burdens. Previously, from 1956 until 1962, similar measurements were made on normal New Mexico subjects. Information has been obtained on cesium-137 burdens in a control population for almost an entire decade. Data obtained from June 1964 to July 1965 and a recapitulation of data obtained during the last decade are presented. (C.H.)

18204 (LA–3432, pp 130-77) CELLULAR RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

Progress is reported in studies on the radiobiology of cells. Data are included from studies on the time of synthesis of RNA and protein species essential to division in hamster cells, Chinese hamster ovary cells, HeLa, and L cells in synchronized suspension cultures; tracer studies, using ^3H-uridine and ^{32}P-phosphate, of RNA synthesis in cultured Chinese hamster ovary cells during thymidine inhibition of DNA synthesis and during synchronous growth following release; the cumulative incorporation of ^{32}P into acid-soluble phosphate, lipid phosphate, DNA, RNA, and phosphoprotein of Chinese hamster ovary cells in culture; measurements of respiratory activity during each phase of the cell cycle in cultured Chinese hamster ovary cells; the isolation of nuclei from Chinese hamster ovary and mouse lymphoma cells in culture; the synthesis of nucleic acids by nuclei from Chinese hamster ovary and mouse lymphoma cells, in which ^3H and ^{14}C were used as tracers for appropriate substrates; emission spectrographic determinations of the content of Ca, Co, Cu, Fe, K, Mg, Mn, Mo, Na, P, and Zn at various times in the life cycle of cultured mammalian cells; and the mechanism of infection of Escherichia coli by phage desoxyribonucleic acid. (C.H.)

18205 (LA–3432, pp 178-262) MOLECULAR RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

Information transfer reactions fundamental to biology were studied in the test tube with enzymes of high purity and synthesized DNA templates competent with DNA polymerase and RNA polymerase characterized as to sequence and size. Chemically synthesized oligo-2′-deoxyribo-5-nucleotide initiators were lengthened from their 3′-hydroxyl end by the addition of from 50 to 300 2′-deoxy-5′-adenylate units using Bollum's terminal deoxyribonucleotidyl transferase as initiator. Specific reaction details are tabulated. The chemical synthesis of oligodeoxyribonucleotides with a variety of known base sequences, results of chemical studies on nucleotide polymerization, ribonucleotide polymerase activities in vitro, and the synthesis of 2′-deoxy-5′-nucleotide p^1,p^2-pyrophosphates are reported. Procedures are described for the analytical chromatography of oligonucleotides, the Sephadex column chromatography of nucleic acid derivatives, high resolution disc electrophoresis of histones, and automated amino acid analysis on the nanomolar level. A computer program was used for the analysis of ultraviolet spectra of multicomponent solutions of nucleic acid derivatives to determine the base ratios in naturally occurring nucleic acids, oligonucleotides, and synthetic polynucleotides. (C.H.)

18206 (N–65-16815) RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE. Quarterly Progress Report No. 15. Levin, Gilbert V.; Horowitz, Norman H. (Hazleton Labs., Falls Church, Va.). Dec. 1964. Contract NASr-10. 43p. (NASA-CR–60709). CFSTI $2.00 cy, $0.50 mn.

Photosynthetic activity of pure cultures of algae by radiological detection methods is reported. Retention and evolution of $^{14}CO_2$ is given for green, blue-green, and red algae, and marine diatom. Two algae were tested for photosynthetic response in buffered systems since results of previous experiments indicated that pH of the test media affected $^{14}CO_2$ exchange. For both organisms, pH had no effect on net $^{14}CO_2$ fixation by live cells. Retention by killed cells in acidified aqueous solution was confirmed. There was no difference in $^{14}CO_2$ evolved in acid or neutral media but there was strikingly greater evolution of $^{14}CO_2$ in alkaline media. The nonmetabolic absorption of $^{14}CO_2$ during the light phase and evolution from controls during darkness at alkaline pH's was as high as metabolic exchange of $^{14}CO_2$, amounting to a complex masking of metabolic activity. The addition of 5% dimethyl sulfoxide did not appear to enhance the inhibitory effect of Bard Parker on Saccharomyces cerevisiae. Seven new test soils and five soil isolates produced positive responses from basal ^{14}C media. A 50% final concentration of unlabeled L-glucose in a labeled inorganic salt medium did not inhibit the growth of Escherichia coli. (STAR)

18207 (NIJS–R–473) STUDIES ON THE NITROGEN METABOLISM IN FROG LIVER AFTER WHOLE-BODY IRRADIATION. IV. INFLUENCE OF SPLENECTOMY, SPLEEN, EXTRACT AND SERUM OF IRRADIATED FROGS ON THE NITROGEN EXCRETION BY PERFUSED FROG LIVER. Antonijevic, M.; Lebez, D. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Dec. 1965. 5p. Dep. mn.

Splenectomy performed 14 days prior to irradiation with 400 R improves the nitrogen balance in the perfused frog liver. Administration of spleen extracts prepared either from normal frogs or frogs exposed to a dose of 650 R resulted in a decrease of nitrogen excretion by perfusate while administration of serum to perfusion liquid had no influence upon nitrogen metabolism in the liver. An attempt to demonstrate the noxious effect of irradiated spleen on the nitrogen metabolism in liver using the spleen extracts of irradiated frogs by perfusion technique was not successful. (auth)

18208 (TID–22715) ACCUMULATION OF CERIUM, YTTRIUM, AND CESIUM IN PLANTS AS AFFECTED BY THEIR SOIL CHEMISTRY AND THE AERATION OF THE SOIL. Progress Report, June 1, 1965–May 31, 1966. Coleman, N. T. (California Univ., Riverside. Dept. of Soils and Plant Nutrition). Contract AT(11-1)-34. 34p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Results are summarized from studies on the accumulation of Cs in plants as affected by soil chemistry. Four soil materials were used to determine how minerals, especially biotite, hydrobiotite, and vermiculite control the availability of Cs to the plants and to establish the role of K, NH_4, and general salt concentration in modifying plant availability under various soil mineral regimes. The textural and general chemical characteristics of the soil samples are summarized. Data are presented from tracer studies of the sorption of Cs under different Cs levels; the Cs fixing capacity under various Cs concentrations; sorption-desorption characteristics of trace amounts of Cs in various soil types and with various salt concentrations; and the uptake of Cs by Sudan grass. (14 references.) (C.H.)

18209 (TID–22717) THE DEVELOPMENT OF CHELATING AGENTS FOR ENHANCING THE URINARY EXCRETION OF STRONTIUM. Report No. 3, February 1, 1963–December 1, 1964. Kroll, Harry; Lipson, Melvin A.; Bolton, Edward F. (Eltex Research Corp., Lincoln, R. I.). Mar. 11, 1966. Contract AT(30-1)-2710. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An attempt was made to synthesize meso- and d,l-stilbenediamine tetraacetic acid for a study on the stereochemical factors influencing chelation reactions. The investigation did not yield the desired chelating agents. A new synthetic route was developed for the synthesis of diethylene triamine used as an intermediate in the synthesis of chelating agents. The utility of the synthesis is discussed. Bis N,N′[(dicarboxymethyl)2-aminoethyl] selenide was synthesized and the stability constants for the alkaline earth chelates of this compound was determined and compared with similar values obtained from related compounds

in which the selenium is replaced by other Group VI elements. (auth)

18210 (UCLA-12-576, pp 15-25) BIOCHEMISTRY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Progress is reported in studies on the formation of hydrocarbons by ^{60}Co γ radiolysis of oleic acid; the metabolism of polyunsaturated fatty acids in mammalian cells in culture; the effect of lipids on enzyme levels in beating rat heart cells; the relation at ATP level to the beating of heart cells in culture; the relation of enzyme changes to the growth of heart cells in culture; and a survey on the relation of deposited wax esters to the natural buoyancy of midwater species of marine fishes. (C.H.)

18211 (UCLA-12-576, pp 89-111) ENVIRONMENTAL RADIATION. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Among populations of Larrea divaricata plants at the Nevada Test Site some irradiated plants were also covered with heavy coatings of fine-particle dust. These plants became defoliated during the following year, followed by recovery. A survey was made of the desert shrub canopy-coverage of the Nevada Test Site and estimates were made on the effects of radiation from the underground thermonuclear detonation of the Sedan, 1962 test on the ecology of desert shrub vegetation. A double-labeled body water technique, using deuterium and ^{18}O, was tested for use in evaluation of the metabolic rate of the pocket mouse. Results are reported from a study of the effects of chronic exposure to low-level γ radiation on the fertility of deer mice; the factors responsible for variations in thyroid content of ^{131}I from contaminated food in rabbits (herbivores) and kangaroo rats (granivores); the effects of radiation on the ecology of rodent populations at the Nevada Test Site; changes in the γ spectra of neutron-irradiated soils; the effect of chelating agents on the movement of fission products in soils of different types; the effects of CO_2 in growth media or soluble Be on the growth of crop plants; the effects of γ radiation on the growth of plants in a Puerto Rican forest; the metabolism of ^{131}I by man as affected by food contamination; the effects of chronic low-level γ radiation on metabolism of lizards, Uta stansburiana, in natural populations. (C.H.)

18212 EFFECTS OF D_2O IN VITRO ON INTESTINAL TRANSPORT OF ARABINOSE, GLUCOSE, AND SODIUM. Bray, David A. (Argonne National Lab., Ill.). Amer. J. Physiol., 210: 619-23(Mar. 1966).

The effect of D_2O in vitro on active and passive transport of arabinose, glucose, and sodium was studied using everted segments of hamster intestine incubated in Warburg flasks. D_2O as a solvent produced an initial retardation of arabinose transport but no effect on ^{22}Na passive transport. Measurements of oxygen consumption indicated that there was no appreciable effect of D_2O on respiration. Active transport of glucose in D_2O was about 30% of that in H_2O; a linear relationship with respect to time was observed with both solvents. The active transport of sodium was also less in D_2O than in H_2O, although the magnitude of the inhibition is not clear; sodium transport was increased to the same extent in both H_2O and D_2O with increasing concentrations of glucose. (auth)

18213 THE BIOLOGICAL DIFFERENTIATION OF ^{99}Mo AND ^{99m}Tc IN RABBITS AND ITS EFFECT ON THE GAMMA-COUNTING RATE OF PLASMA SAMPLES. Robinson, G. A.; McCarter, A. (Univ. of Guelph, Ontario). Can. J. Biochem., 44: 363-70(Mar. 1966).

Thirty-one rabbits were each injected intravenously with 250 to 450 μcuries molybdate-^{99}Mo in transient equilibrium with ^{99m}Tc. Blood samples were taken at intervals from 0.5 to 48 hours after the isotope injections. The gamma-counting rate of the blood plasma was recorded at 13 intervals during the 96 hours subsequent to the bleedings. Gamma curves, uncorrected for nuclear decay, were biphasic for 151 of the 194 samples. Recognizable first components (mean half-life ± s.e.m., 6.12 ± 0.10 hours) represented the buildup of ^{99m}Tc to equilibrium levels in 53 samples (38 of these from rabbits fed on control diets) and decay of excess ^{99m}Tc in 101 others (65 for rabbits fed on diets containing 0.4% Na_2MoO_4). The second components (mean half-life 65.9 ± 1.1 hours) represented a condition of transient equilibrium between ^{99}Mo present in the samples at time of bleeding and the daughter nuclide. Biological differentiation of ^{99}Mo and ^{99m}Tc as observed in this study indicated that the indiscriminate measurement of gamma emissions for ^{99}Mo-containing systems may give apparent ^{99}Mo concentrations 0.57 to 2.31 times the actual values. Counting of either the total beta emission or a specific ^{99}Mo gamma energy is recommended when the measurement of ^{99}Mo is attempted. (auth)

18214 CHEMICAL AND BIOLOGICAL EFFECTS OF DEUTERIUM AND ITS COMPOUNDS. Juraskova, Vera (Biofysikalini ustav CSAV, Brno). Chem. Listy, 59: 1405-14(1965). (In Czech).

The physical properties of hydrogen, deuterium, and light and heavy water are summarized. The exchange of deuterium and hydrogen occurs readily in compounds with labile hydrogens, while in other cases catalysts or elevated temperatures are required to bring about exchange. The exchange of hydrogen and deuterium in many compounds of biological origin is reviewed, and giving the extent of exchange under various conditions is considered. The effects of the hydrogen isotopes are attributed to the change in the relative velocity of reactions when deuterium is substituted for hydrogen, even such slight changes in velocity being capable of causing profound changes in complex biological systems. For example, the complex, multi-stage condensations in which nucleic acids are involved can be influenced in this way, thus leading to profound changes in the biological processes. A number of studies on the influence of deuterium or deuterated compounds on bacteria and other organisms are briefly summarized. A bibliography of 100 references is included. (TTT)

18215 CERTAIN REGULARITIES IN THE ACCUMULATION OF YTTRIUM AND STRONTIUM BY MARINE ORGANISMS. Parchevskii, V. P.; Polikarpov, G. G.; Zaburunova, I. S. (Kovalevskii Inst. of Biology of South Seas, Academy of Sciences, Ukrainian SSR). Dokl. Akad. Nauk SSSR, 164: 913-161965). (In Russian).

The potential correlation between the buildup factor of radioisotopes in hydrobionts and their activity in the water was investigated using ^{91}Y and ^{90}Sr. The experiments were carried out in aquaria containing sea water with added activities of the isotopes in the ranges of 10^{-7}, 10^{-8}, 10^{-9}, 10^{-10}, and 10^{-11} C/liter on young shoots of the seaweed Ulva rigida. The accumulation of ^{91}Y, determined by a liquid scintillation counter was found to be independent of the activity of the water. Ulva rigida, Cystoseira barbata, Zostera marina, Mytilusgallo provincialis were used in ^{90}Sr studies. The activity values obtained were high because the natural activity of ^{40}K was included, together with artificial contaminations in the seawater; for concentrations below 10^{-10} C/liter corrections must be made. The buildup factors were similar for stable Sr and ^{90}Sr for the 3 plants but there was a marked difference in the case of the mollusk because the accumulation is a function of its growth. It may be assumed that the radioisotope does not cause biological changes, as in the penetrability. (TTT)

18216 REMOVAL OF ^{60}Co AND ^{65}Zn FROM THE MAMMALIAN BODY. Catsch, A.; Le, D. Kh. (Kernforschungszentrum, Karlsruhe, Ger.). Experientia, 21: 724(1965).

Carrier-free $^{60}CoCl_2$ or $^{65}ZnCl_2$ were injected intravenously into rats prior to intraperitoneal administration of Ca-, Zn-, and Co(II)-DTPA. Whole-body radioactivity was determined 48 hrs after chelate administration. Isotope exchange was found to be a more efficient decontamination modality than chelation. (H.G.D.)

18217 OXIDATION OF CHOLESTEROL BY RAT LIVER MITOCHONDRIA: INFLUENCE OF DEUTERIUM OXIDE. Kritchevsky, D.; Tepper, Shirley A. (Wistar Inst. of Anatomy and Biology, Philadelphia). Experientia, 22: 84 (1966).

The effects of D_2O on the oxidation of cholesterol and sodium octanoate by rat liver mitochondria were studied. Incubations were carried out at pH 8.1 and 8.5. Parallel experiments were performed using mitochondria prepared from both male and female rat liver. In D_2O at pH 8.5 the oxidation of both substrates was markedly inhibited. The oxidation of octanoate in D_2O at pH 8.1 was roughly equivalent to that observed at the higher pH, but oxidation of cholesterol in D_2O virtually ceased. It is assumed that normal nuclear oxidation of cholesterol occurred in D_2O, but the rate of conversion may have been slower and that, coupled with inhibition of scission of the side chain, resulted in the observed reduction in the extent of cholesterol oxidation. Cholesterol oxidation was much lower in preparations from male rat liver than those from the females. (H.G.D.)

18218 EFFECT OF HEAVY WATER D_2O ON RESISTANCE OF PLANT AND ANIMAL CELLS, CELL MODELS AND PROTEINS TO CERTAIN DENATURING FACTORS. Aleksandrov, V. Ya.; Arronet, N. L; Den'ko, E. I.; Konstantinova, M. F. (Botanical Inst. and Inst. of Cytology, Leningrad). Federation Proc., Transl. Suppl., 25: T128-T134(Jan.-Feb. 1966).

Translated from Tsitologiya, 6: 667(1964).

Replacing H_2O in the medium by D_2O raises the resistance to heat of epidermal cells from Campanula persicoefolia leaves, ciliated cells from frog palatine mucosa, glycerinated models of these ciliated cells and the ATPase activity of actomyosin from frog skeletal muscles. Replacing H_2O in the medium by D_2O raises resistance to high hydrostatic pressure of epidermal cells of Campanula persicoefolia, the ciliated cells of the frog and ATPase activity for actomyosin. The stability of all specimens increases very rapidly in D_2O; 1-sec contact with D_2O suffices in the case of the ciliated cells to obtain an effect. The analogous effect of D_2O on stability in live cells, glycerinated cell models and proteins in relation to denaturing agents is fresh evidence of the prime importance of disturbance in configuration of protoplasmic proteins in damage to the cell. It is argued that the stabilizing effect of D_2O on the macrostructure of protein molecules may be at the root of the universal ability of D_2O to inhibit diverse physiologic processes of plant and animal cells and microorganisms. (auth)

18219 EFFECT OF HIGH-FREQUENCY PHYSICAL AGENTS ON ABSORPTION OF RADIOACTIVE PHOSPHORUS IN THE INTESTINE. Feitelberg-Blank, V. R. (Inst. for Research and Physiotherapy, Odessa). Fiziol. Zh., Akad. Nauk Ukr. RSR, 11: 802-7(1965). (In Russian).

Absorption of radioactive bi-substituted phosphate salt in the intestine in the normal state and under the influence of superhigh-frequency (SHF) and ultrasonic vibrations was studied on six dogs with isolated intestinal loops by Thiry's method. The effect of SHF of 70 and 120 watts acting on the organism for 10 minutes and of ultrasonic vibrations of 0.5 and 1.5 w/cm^2 for 5 minutes on the resorption of radioactive phosphorus in the intestine was investigated. It was found that SHF of 70 w and ultrasonic vibrations of 0.5 w/cm^2 raise resorption of radioactive salt in the intestine. SHF of 120 w and ultrasonic vibrations of 1.5 w/cm^2 lower resorption of radioactive phosphorus. Results are explained by the involvement of the nervous system in the mechanism of the effect of the investigated agents on the processes of radioactive salt absorption in the intestines. (auth)

18220 CORRELATION OF ^{137}Cs CONCENTRATIONS IN MILK, URINE, AND THE WHOLE BODY. Boni, A. L. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Health Phys., 12: 501-8(Apr. 1966).

The metabolism of environmental ^{137}Cs in twenty adult males was studied for a period of 2 years. A material balance was made of the ingestion, excretion, and assimilation of the radionuclide by the body. The fate of the radionuclide was observed, and simple relationships were established to assess and evaluate the hazard of ^{137}Cs to man. An apparent correlation was observed between the ^{137}Cs content in man and urine. Ingestion via milk and dairy products accounted for 86 per cent of the total ^{137}Cs assimilated. The biological half-life for adults averaged 93 days, ranging from 68 days in the summer to 130 days in the winter. The ^{137}Cs content was much higher in children's urine than in adults' urine; it appears that the biological half-life for children is much less than that for adults. (auth)

18221 ^{237}Pu LABELING: A NEW TECHNIQUE FOR PLUTONIUM METABOLIC STUDIES IN ANIMALS. Todd, R.; Logan, R. (United Kingdom Atomic Energy Authority, Annan, Scotland). Int. J. Appl. Radiat. Isotop., 17: 253-5 (Apr. 1966).

The use of ^{237}Pu in metabolic studies is assessed. Advantages include: simple, rapid, reasonably accurate determinations of Pu without destruction of the deposition sites; a fairly accurate determination of skeletal burdens in vivo; availability of several quantities of carrier ^{239}Pu and the possibility of almost immediate assessment of residual plutonium. Disadvantages are inconvenience of preparation and availability deficiencies. (H.G.D.)

18222 METABOLISM OF ZINC IN LIVER CIRRHOSIS USING ^{65}Zn. Abdel-Wahab, M. F.; Ibrahim, M. S.; Meghed, Y. M. (Radioisotope Center, Cairo). J. Chem. UAR, 7: 113-30(1964).

Zinc-65 was given to 11 normal subjects and 15 patients with liver cirrhosis to study its liver uptake, blood concentration, clearance, and excretion in feces and urine. Zinc-65 gluconate was given in intravenous doses ranging from 50 to 150 μC. Using a two-channel scintillation ratemeter, one probe was placed over the lower part of the chest, facing the liver, and the other over the thigh. Both probes were placed in close contact with the skin with a collimator 1 cm ID. The radioactivity registered from both sites was simultaneously recorded for three hours. Subsequent readings are taken for about two weeks. The radioactivity was recorded for the direct uptake curve and the delay uptake curve. Activities of whole blood, plasma, and red cells were also determined daily up to four weeks by a scintillation counter. The results demonstrated striking differences between normal subjects and patients with liver cirrhosis in metabolizing radiozinc. The uptake of the radioactivity by the cirrhotic liver appeared to be much decreased, the degree of impairment being proportional to the severity of hepatic dysfunction as judged clinically. Direct correlation with conventional liver function tests was not observed. As zinc, accumulated in the liver, is incorporated into specific enzymes in liver cells, impaired uptake may be attributed to change in activity or deficiency involving these enzymes. (TCO)

18223 EFFECT OF SODIUM CHLORIDE ADMINISTRATION ON ^{131}I RETENTION IN CALVES. Barth, K. M.; Plumlee, M. P.; Kessler, W. V.; Christian, J. E. (Purdue Univ., Lafayette, Ind.). J. Dairy Sci., 48: 1535-6(Nov. 1965).

Alterations of ^{131}I metabolism in the dairy cow are among the possible countermeasures to milk contamination by this radionuclide; thus, an increased elimination of ^{131}I via the urine could decrease its retentions in the body, and therefore, its contamination of milk. Calves were dosed with 0.3 μC of carrier-free ^{131}I (as NaI), administered orally in milk replacer. Whole-body retention of ^{131}I was determined 3 hr after administration of the radionuclide and on days 4, 7, 11, and 18. When a single dose of NaCl was administered, the per cent ^{131}I dose retained was markedly decreased during all test periods. This decrease in body retention of ^{131}I probably is the result of increased urinary excretion. Thus, the effect of sodium chloride on radioiodine excretion in calves may be similar to that in dogs and rats, but in contrast to the effect in humans. Since whole-body ^{131}I retention in calves was considerably decreased when carrier iodine was given before and after administration of this radionuclide, the combined effect of carrier iodine administration and chloride flushing was tested. The results indicated that chloride treatment was more effective in reducing ^{131}I retention

during the beginning of the trial, whereas the continuous carrier iodine treatment was more effective in the end. The combined treatments caused the lowest retention of ^{131}I at each time interval. (BBB)

18224 ACCUMULATION OF ^{90}Sr IN THE BONES OF RATS AS A RESULT OF THE PHYSICO-CHEMICAL FORM OF THE ISOTOPE IN MILK. Puchkova, S. M.; Meshalkin, G. S. Med. Radiol., 10: No. 11, 76-8(Nov. 1965). (In Russian).

The accumulation of ^{90}Sr was studied in experiments on rats that were daily given milk containing ^{90}Sr bound in complexes and ionized. Milk of three types was administered to different groups of rats. Samples of milk were daily analyzed for the content of calcium, magnesium, titrated acidity, and ^{90}Sr. It was found that the accumulation of ^{90}Sr in the bones of rats did not depend on the physico-chemical state of the isotope introduced. (auth)

18225 STUDIES ON EXPERIMENTAL RADIATION INJURY IN MICE BY INTERNAL ^{90}Sr. I. CHANGES IN ^{90}Sr CONCENTRATION OF BLOOD, FEMUR AND SOME ORGANS AFTER ADMINISTRATION OF ^{90}Sr. Hayashi, Mitsuaki; Miyao, Noboru (National Inst. of Animal Health Tokyo). Nat. Inst. Anim. Health Quart., 5: 225-30(Winter 1965).

Four-week-old mice were given ^{90}Sr and observed for the total retention of ^{90}Sr and the ^{90}Sr concentration per unit weight of calcium in bone, blood, and other organs. The total retention of ^{90}Sr was 28.4, 18.9, and 17.6% of the dose injected intraperitoneally, 29.8, 29.6, and 19.1% of that injected subcutaneously, and 5.9, 4.2, and 4.2% of that administered orally on the 5th, 15th, and 45th day, respectively. The ratio of the sum total of ^{90}Sr retentions in five organs (heart, lung, liver, spleen, and kidney) to the total retention in the body was 0.628 on the 5th day, 0.105 on the 15th day, and 0.054 on the 45th day after the intraperitoneal injection. The mean ratio of the ^{90}Sr concentration (dpm/mg · w.w.) in the five organs to that in the femur was 0.566, 0.074, and 0.055% on the 5th, 15th, and 45th day, respectively, after the intraperitoneal injection. The ratio of the concentration (dpm/mg · Ca) of ^{90}Sr in the blood to that in the femur was 0.15 on the 15th day and 0.12 on the 45th day after the intraperitoneal injection. It appeared to be approximately constant. In the case of intraperitoneal injection, the concentration (dpm/mg · Ca) of ^{90}Sr in blood and femur showed little change. (auth)

18226 PLASMA CONCENTRATION AND EXCRETION OF ^{47}Ca, ^{85}Sr, ^{133}Ba AND ^{223}Ra FOLLOWING SUCCESSIVE INTRAVENOUS DOSES TO A HEALTHY MAN. Harrison, G. E.; Carr, T. E. F.; Sutton, Alice; Rundo, J. Nature, 209: 526-7(Jan. 29, 1966).

Quantitative data on biological discriminations between ^{47}Ca and ^{85}Sr and between ^{133}Ba and ^{223}Ra were studied in a healthy adult male. Results for the plasma concentration and excretion following separate intravenous injections of four radioisotopes are presented. The concentrations of ^{133}Ba and ^{223}Ra were indistinguishable over the period of measurement, and after an hour they were more than an order of magnitude less than those of ^{85}Sr and ^{47}Ca. Renal clearance for Sr was 3.2 times that for Ca. Results for the renal clearance of ^{133}Ba and ^{223}Ra (mean values 10.2 and 3.4/day respectively) appear to be the first reported for man. (H.G.D.)

18227 UPTAKE OF PLUTONIUM BY THE LOBSTER HOMARUS VULGARIS. Ward, Eileen E. (United Kingdom Atomic Energy Authority, Windscale Works, Eng.). Nature, 209: 625-6(Feb. 5, 1966).

Plutonium-239 uptake was studied in lobsters maintained in aerated filtered sea water to which 6.5×10^{-2} $\mu C/l$ ^{239}Pu was added. The cast shells were analyzed for ^{239}Pu 100 days after the lobsters were placed in the radioactive solutions: soft tissues were analyzed after 220 days. The calcified skeleton, which accounts for approximately 43% of the total weight, contained 89.5% of the total Pu; whereas the flesh comprising approximately 28.7% of the body weight, contained only 1.2% of the Pu contained in the whole body. (H.G.D.)

18228 EFFECT OF DEUTERIUM OXIDE ON THE RELAXATION OF GLYCEROL-EXTRACTED MUSCLE. Kaminer, Benjamin (Inst. for Muscle Research, Woods Hole, Mass.). Nature, 209: 809-10(Feb. 19, 1966).

Preparations of rabbit psoas muscle that have the property of spontaneous relaxation after ATP-induced contraction are known to lose this property on pre-soaking in water-salt solution for variable periods of time. Soaking in deuterium oxide reduced the rate of this loss. However, deuterium oxide did not reverse the inactivation caused by water. (H.G.D.)

18229 INFLUENCE OF SODIUM SALICYLATE ON RADIOACTIVE STRONTIUM RETENTION IN RAT AND MOUSE. Bates, T. H.; Smith, H. (United Kingdom Atomic Energy Authority, Dumfriesshire, Eng.). Nature, 209: 824-5(Feb. 19, 1966).

Reduction of ^{85}Sr body burdens in rats with sodium salicylate was investigated in view of its evident pharmacological activity, its possible chelating properties, and its low toxicity. The effectiveness of salicylate in improving excretion of radiostrontium was established in mice and rats. The salicylate did not appear to be maximally effective until 48 hrs after administration of the isotope, ruling out the possibility that salicylate is acting as a chelate. Observation of diuresis suggests that renal tubular resorption processes are involved. Renal output of ^{85}Sr is increased after 24 hrs, while fecal output remains the same. The preferential excretion persists for several days. (H.G.D.)

18230 URINARY ELIMINATION OF LABELED ESTROGENS AND KETOSTEROIDS AFTER INJECTION OF 1,2-^{3}H TESTOSTERONE IN MAN. Bolt, W.; Ritzl, F.; Bolt, H. M. (Univ., Cologne. Kernforschungsanlage, Juelich, Ger.). Nucl.-Med., Suppl. 3, 311-18(1965). (In German).

When tritium-labeled testosterone was injected into six males and one female, labeled estrone, estradiol, and 16-epiestrol were excreted. Elimination of radioactivity was greatest in the first 24-hr period following injection. Results show, moreover, that testosterone is not changed into estrogens in the urine. Urinary activity was found primarily in the 17-ketosteroids. (H.G.D.)

18231 NONCONSERVATIVE DNA REPLICATION IN BACTERIA AFTER THYMINE STARVATION. Pauling, Crellin; Hanawalt, Philip (Stanford Univ., Calif.). Proc. Natl. Acad. Sci., 54: 1728-35(Dec. 1965).

The qualitative nature of DNA replication that immediately follows thymine starvation was investigated in E. coli. Results implicate a mechanism of nonconservative DNA replication in the phenomenon of thymineless death. A model is discussed in which the routine transcription of messenger RNA on the DNA results in single-strand breaks that must be repaired. The model accounts for many of the observed pathological effects of thymine deprivation in bacteria. (H.G.D.)

18232 LONG-TERM STUDIES ^{90}Sr IN SOILS AND PASTURES. Squire, H. M. (Agricultural Research Council, Wantage, Eng.). Radiat. Bot., 6: 49-67(Feb. 1966).

The movement of ^{90}Sr in soil and its absorption by ryegrass were studied over a period of 8 years. Carrier-free ^{90}Sr was added to the surface of nine soils which contrasted in pH, exchangeable calcium, clay and organic matter and which were exposed to natural weather conditions in concrete cylinders. The downward movement of ^{90}Sr was greatest in soils which contained over 20 m-equiv./100 g exchangeable calcium and least in a clay soil containing 3 m-equiv./100 g; after 6 years the median depth ranged from 5 to 3 cm. The annual addition of fertilizer to the low calcium soil caused an increase of 400 per cent in median depth; there was a slight increase in the medium calcium soils but none in the calcareous soils. In all soils movement was unaffected by cropping with ryegrass. Differences between soils in the relative absorption of ^{90}Sr and calcium by ryegrass were due mainly to the calcium content of the soils and to the depth to which ^{90}Sr had penetrated. Physico-chemical changes during the experiment reduced the

availability of ^{90}Sr by less than 10 per cent. The $^{90}Sr/Ca$ ratio in ryegrass bore a curvilinear relationship to the exchangeable Ca content of the soils, but there was a closely linear relationship between the ratio and the fraction of ^{90}Sr which was displaced from the soils by 0.01 M calcium chloride. This is attributed to the fact that the displacement of ^{90}Sr by this solution depends on the ratio of the two ions in the soil solution. Over the first 4 years the downward penetration of ^{90}Sr reduced the $^{90}Sr/Ca$ ratio by 10 to 15 per cent per year; after the fifth year there was little further change. Annual additions of fertilizer to the soil surface altered the $^{90}Sr/Ca$ ratio in ryegrass by up to 30 per cent; in all but the calcareous soil there was initially an increase, due to the displacement of ^{90}Sr from exchange sites; in the latter years this was counteracted by increased penetration. (auth)

18233 THE HALF-TIME OF ^{137}Cs IN MAN. McCraw, T. F. (Atomic Energy Commission, Germantown, Md.). Radiol. Health Data, 6: 711-18(Dec. 1965).

Data available on the half-time of ^{137}Cs in man are summarized. A model is presented for expressing ^{137}Cs half-time as a function of age, and estimates are made of doses and body burdens for a given intake of ^{137}Cs and for the intake of ^{137}Cs in milk, using an assumed pattern of milk consumption by individuals of various ages. The data indicate that the biological half-time for ^{137}Cs in man is a function of age and that the dose varies from birth through adult life by a factor of 4 to 5, with males 15 to 20 years of age having the highest body burdens. (C.H.)

18234 THE RELATION BETWEEN ^{137}Cs IN MAN AND HIS DIET IN THE CHICAGO AREA. Gustafson, Philip F. (Argonne National Lab., Ill.). Radiol. Health Data, 6: 719-22(Dec. 1965).

Because of the relatively short biological half-life of ^{137}Cs in man (approximately 100 days for adults), changes in the ^{137}Cs content of the diet lead fairly rapidly to corresponding changes in the human burden of ^{137}Cs. Equilibrium, or near-equilibrium between diet and body burden can be attained within a few months. Data are presented from a survey on the daily ^{137}Cs intake derived from 5 diet categories from 1961 through July 1965. In general, meat, milk, and grain products provided most of the ^{137}Cs intake. (C.H.)

18235 SPIROELECTROMETRIC DETECTION OF ALPHA- AND BETA-EMITTING NUCLIDES LODGED IN THE RESPIRATORY TRACT. Sanders, S. Marshall Jr.; Brown, Mark. Radiology, 86: 344-5(Feb. 1966).

Design features are described, and illustrated schematically, of a spiroelectrometer capable of measuring 10^{-15} amperes in a changing mixture of oxygen and CO_2 saturated with water vapor at 37°C flowing at a rate of 500 ml/sec. Exhaled breath passes through a specially designed ion-collecting chamber into a respirometer where CO_2 is removed by a soda lime canister. Oxygen is inhaled from the respirometer through an ion trap to ensure the measurement of only those ions generated in the lungs. Exhaled ions produced by microcurie amounts of intrapleural ^{239}Pu or ^{32}P and intravenous ^{32}P in the tracheobronchial tree of dogs were readily detected by this technique. (C.H.)

18236 RADIOISOTOPES AND POULTRY. Mraz, F. R. (Univ. of Tennessee, Oak Ridge). Contract AT (40-1)-GEN-242. World's Poultry Sci. J., 21: 238-61 (July-Sept. 1965).

The use of radioisotopes in poultry research is reviewed. The greatest number of radioisotope studies conducted in poultry have been in the field of calcium and phosphorus metabolism, because of the economic importance of elemental calcium and phosphorus for both growth and egg production. Magnesium-28 metabolism has also been studied. Studies in radioiodine metabolism approach those with calcium and phosphorus in number, primarily because of its relation to the thyroid and thyroxine. Radio-thyroidecrexis, a term used to denote the destruction of thyroid tissue by the emissions from radioiodine, is discussed. Cobalt-60 and vitamin B_{12} metabolism are considered, and studies involving metabolism of ^{3}H-, ^{14}C-, and ^{35}S-labeled metabolites are also surveyed. (TCO)

18237 EFFECT OF RARE EARTH ELEMENTS FROM MONAZITE ON GROWTH-VIGOR AND CHEMICAL COMPOSITION OF PHASEOLUS VULGARIS. Sharoubeem, H. H.; Milad, N. E. (A'in Shans Univ., Cairo). Soil Sci., 101: 130-4(Feb. 1966).

The effects of different concentrations of rare earth elements (as monazite extract containing Th, Ce, La, Pr, and Nd in the form of nitrates) on the growth and nutritional status of Phaseolus vulgaris were studied. Phaseolus vulgaris plants were grown in sand cultures to which rare earths were added to supply 2.5, 5, 7.5, and 10 ppm. Growth of both tops and roots showed a marked response to rare earths application, especially in the development of tops. The addition of rare earths to the culture solution resulted in: better development of plant tops and roots; increased water content of roots; and increase of the dry matter of tops more in proportion than the dry matter of their roots. Application of rare earths increased the nitrogen, potassium, and sodium contents of the experimental plant tops up to a maximum at the level of 5 ppm rare earths. (H.G.D.)

18238 PROGRESS IN BIOCHEMICAL PHARMACOLOGY. VOL. 1. 1st International Symposium on Radiosensitizers and Radioprotective Drugs, Milan, 1964. Paoletti, R.; Vertua, R. (eds.). Washington, D. C., Butterworths, 1965. 760p. $28.50. CONF-640512(Vol.1).

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Separate abstracts were prepared on 85 papers. Four papers were abstracted previously and appeared in NSA Vol. 18 as number 2337, Vol. 19 as numbers 3994 and 13092, and Vol. 20 as number 204. (C.H.)

For abstracts of individual papers see: 18239–18242, 18274–18276, 18372–18381, 18444–18497, 18504, 18533–18543, 18722, 18790, and 18791.

18239 THE INFLUENCE OF AET AND CYSTEAMINE ON BLOOD PRESSURE RESPONSES TO REPEATED ACETYLCHOLINE AND ADRENALINE TEST INJECTIONS IN RATS. Schliep, H. J.; Michailov, M. Ch. (Gesellschaft fuer Strahlenforschung mbH, Neuherberg, Ger.). Progr. Biochem. Pharmacol., 1: 249-56(1965).

Results are reported from studies on the effects of AET and cysteamines on blood pressure responses of rats to repeated injections of acetylcholine or adrenaline. (C.H.)

18240 SOME METABOLIC ASPECTS OF CYSTAMINE-TREATED MICE. Ciccarone, P. (C.S.N., Casaccia, Italy). Progr. Biochem. Pharmacol., 1: 522-7(1965).

The mechanism by which cystamine induces metabolic inhibition was investigated in mice given a dose that would protect against lethal radiation exposure. The animals were sacrificed at various times after the injection of 170 mg/kg cystamine and the effects of pyruvate, ketoacids, and coenzyme A on cystamine-induced reduction of oxygen uptake of liver homogenates were measured. A tentative hypothesis for the effect of cysteamine on metabolism is presented. (C.H.)

18241 INVESTIGATION OF THE INFLUENCE OF THE "FREUND ADJUVANT" ON THE UPTAKE OF RADIOCOLLOIDS BY THE LYMPH NODES. Bellion, B.; Buechi, G.; Chiarle, S.; Sosi, S. (Univ., Turin. Nuclear Research Centre, Sorin, Italy). Progr. Biochem. Pharmacol., 1: 586-90(1965).

The possible relationship between the uptake of radiocolloids by the lymph nodes and the degree of histocytic hyperplasia induced artificially was investigated in rabbits. Colloidal preparations of $^{32}PCr(OH)_3$ were injected subcutaneously into the hind leg of animals that had been given 0.5 ml of Freund adjuvant by injection at the same site or untreated animals. The animals were sacrificed 24 hr after injection of the colloid and the lymph nodes were examined autoradiographically and histologically. The uptake of colloid by lymph nodes was considerably increased in animals pre-treated with the Freund adjuvant. (C.H.)

18242 ACTION OF DIETHYL-DITHIOCARBAMATE (DEDTC) AGAINST THE TOXICITY OF MECHLORETHAMINE (HN_2) IN SELECTIVE RADIOMIMETIC PULMONARY

PERFUSION. Sossai, M.; Pozza, F.; Cima, L.; Calzavara, F.; Toth, C. E. (Univ. of Padua). Progr. Biochem. Pharmacol., 1: 720-4(1965).

Merchlorethamine is used for the chemotherapy of tumors but it has undesirable side effects when used in high concentrations. A search was made of compounds that would reduce the toxic effects of merchlorethamine. Of the various radioprotective compounds that react with alkylating agents tested, sodium diethyl-dithiocarbamate gave the maximum protective action against the toxicity of merchlorethamine in dogs. Possible reaction mechanisms involved are discussed. (C.H.)

Radiation Effects on Biochemicals

See also CHEMISTRY — Radiation Chemistry

Refer also to abstracts 18196 and 18291.

18243 (NIJS-R-454) CHANGES IN THE COMPOSITION OF FROG SERUM PROTEINS AFTER WHOLE-BODY IRRADIATION. Lebez, D.; Antonijevic, M.; Furlan, M. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). June 1965. 3p. Dep. mn.

The nitrogen concentration of blood serum and the composition of serum proteins were investigated in whole-body γ-irradiated frogs. Blood was taken from females 1, 2, and 5 days after exposure to 650 R. Neither electrophoretic patterns of frog serum proteins nor total serum nitrogen were in accord with data obtained previously on mammalian sera. No significant changes were found in the relative amounts of G_I and G_{II} globulin fractions. It is suggested that the observed serum albumin increase is due to the enhanced protein synthesis in the liver where accumulated dead cells are being broken down. (H.G.D.)

18244 (NIJS-R-467) EFFECT OF LOCAL IRRADIATION ON THE PROTEOLYTIC ACTIVITY OF LEUCOCYTES IN CANCER PATIENTS. Kopitar, M.; Skrk, J.; Savnik, L.; Lebez, D.; Poniz, T.; Komar, J.; Fabjan, B.; Furlan, M.; Strukelj, V. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Nov. 1965. 12p. Dep. mn.

Effects of small, local radiation doses on cathepsin activity were studied in leukocytes of cancer patients. The catheptic activity of leukocytes before and after radiotherapy is described. A therapeutic dose of 100 R or 2 × 150 R gave rise to a considerable increase in the catheptic activity of leukocytes. The differential blood picture and the leukocyte count, as compared with the blood picture of healthy controls, did not change significantly. (H.G.D.)

18245 (SGAE-BL-16/1965) CHARGE TRANSFER: A FACTOR OF RADIORESISTANCE. Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Siebersdorf. Institut fuer Biologie und Landwirtschaft). Oct. 1965. 9p. Dep. mn.

Explanations are given to explain the reaction in which excitation energy and charge may migrate over large distances in biomacromolecules by solid state mechanisms. Next two problems in which charge transfer are involved are discussed. The first is the removal of trace elements from nucleic acids by radiation and the second is the sensitization of microörganism by bromodeoxyuridine. (P.C.H.)

18246 (UH-235P5-1, pp 7-13) RADIATION EFFECTS ON PROTEIN AND PECTIN IN PAPAYA. Young, Richard L.; Lin, Mary (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Proteolytic activity, protein content, and pectin characteristics were studied in papaya fruits exposed to gamma radiation from the Hawaii Research Irradiator. The effects of gamma irradiation on the proteolytic activity and protein content of papaya did not show a consistent pattern of change with dosage. However, the protein level was always maintained throughout the ripening of the fruit, and there was no evidence of enzyme destruction. Radiation affected the pectin structure by decreasing the percent of esterified uronic acid with increasing dose. Uronic acid was demethylated but was not destroyed. (H.G.D.)

18247 (UH-235P5-1, pp 14-25) ORGANOLEPTIC EVALUATION OF IRRADIATED PAPAYA. Wong, Roland; Cavaletto, Catherine; Ross, Edward (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Organoleptic tests were conducted to determine the effect of gamma irradiation on the quality of papaya. Flavor, texture, aroma, and color were evaluated by trained panels using the conventional triangular test. Preliminary results showed that a 75 krad dose produced no adverse organoleptic effects and possibly improved the flavor. (H.G.D.)

18248 (UH-235P5-1, pp 52-4) EFFECT OF GAMMA RADIATION ON ASCORBIC ACID CONTENT IN PAPAYA. Hilker, Doris M. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Ascorbic acid content was measured in papaya fruits in varying degrees of ripeness and following different doses of ionizing radiation. The reduced ascorbic acid was determined by a modification of the 2,6-dichlorophenolindophenol dye method. There was no decrease in ascorbic acid at any stage of ripeness tested at irradiation doses of 25 or 75 krad. At 100 krad, there was a consistent but small decrease. It was concluded that the nutritional quality of papaya with respect to vitamin C is not decreased by dosages tested. (H.G.D.)

18249 EFFECTS OF ULTRAVIOLET LIGHT ON THE BIOLOGICAL FUNCTIONS OF TRANSFER RNA. Buc, Marie-Helene, Scott, Jesse F. (Harvard Univ., Boston). Contract AT(30-1)-2643. Biochem. Biophys. Res. Commun., 22: 459-65(Mar. 8, 1966).

Comparative effects on the acceptance capacity of t-RNA and t-RNA charged with ^{14}C-labeled amino acids to: bind non-enzymatically to the ribosome; artificial messenger complex and to participate in the complete enzymatic system for the formation of polypeptide are reported. The ratio of initial t-RNA acceptance slopes for t-RNA from bakers's yeast and for that from E. coli varied over approximately a 20-fold range. Relative sensitivities of t-RNA from E. coli were compared for three functions of t-RNA: acceptance of phenylalanine form the aminoacyl ligase; the non-enzymatic binding of the charged t-RNA to the messenger, ribosome complex; and the enzymatic transfer of the amino acid from t-RNA to polypeptide linkages. Results inferred a very large difference in the sensitivity of t-RNA for the acceptance step and for the non-enzymatic binding step. The phenylalanyl acceptor was essentially insensitive to uv-irradiation for the latter function in the dose range covered. Significant sensitivity of charged t-RNA to uv-irradiation for the enzymatic transfer of phenylalanine implied a necessary interaction between the t-RNA molecule and one or more of the enzymes involved in the peptide bond formation, an interaction that is sensitive to alteration of the structure of the RNA molecule. (H.G.D.)

18250 EFFECT OF ULTRAVIOLET IRRADIATION ON COMPOSITION AND FUNCTION OF CARBOXYPEPTIDASE A. Piras, Romano; Vallee, Bert L. (Harvard Medical School, Boston. Peter Bent Brigham Hospital, Boston). Biochemistry, 5: 849-54(Mar. 1966).

Irradiation with ultraviolet light at 2537 Å increases the esterase and decreases peptidase activities of carboxypeptidase A. These alterations in function can be related to three distinct changes in composition as indicated by amino acid and zinc analyses at different stages of irradiation. First, irradiation results in an irreversible loss of zinc and a proportionate decrease of both esterase and peptidase activities. Second, low doses of irradiation destroy tyrosyl residues. This is thought to account for an increase in esterase activity, similar to that previously observed on acylation or iodination. Third, with increasing doses of irradiation, tryptophan and histidine are destroyed also. The relationship between these changes in chemical composition and the activity profiles of the enzyme is discussed. (auth)

18251 STRUCTURAL CHANGES OF CARBOXYPEPTIDASE A ON ULTRAVIOLET IRRADIATION. Piras, Romano; Vallee, Bert L. (Harvard Medical School, Boston. Peter Bent Brigham Hospital, Boston). Biochemistry, 5: 855-60(Mar. 1966).

Ultraviolet irradiation (2537 Å) alters the structure of carboxypeptidase A. Optical rotatory dispersion reveals a decrease in the magnitude of the Cotton effect at 233 mμ and a change of b_0 from −216 to −132. On ultracentrifugation, formation of rapidly sedimenting polydispersed material is apparent. Gel filtration on Sephadex G-75 demonstrates the existence of three species, two of which are denatured and have a high R_F value. One species emerges with the R_F value of native carboxypeptidase. The esterase activity of this material, however, is increased markedly, accounting for the increased esterase activity of the unseparated mixture. Amino acid analysis of this fraction shows the destruction of one tyrosyl residue. Irradiation of lysozyme and α-chymotrypsin demonstrates that such structural changes are not restricted to carboxypeptidase. These results suggest caution in correlating alterations of enzymatic activities on irradiation with the destruction of specific amino acid residues, without concomitant examination of the physicochemical properties of the system. (auth)

18252 ULTRAVIOLET-LIGHT-IRRADIATED COLLAGEN MACROMOLECULES. Fujimori, Eiji (Air Force Cambridge Research Labs., Bedford, Mass.). Biochemistry, 5: 1034-40(Mar. 1966).

Collagen macromolecules undergo photopolymerization when irradiated with ultraviolet light of 2537 Å. The absorption spectrum of irradiated collagen shows an increase in extinction at the longer wavelengths (290 to 400 mμ). The decrease of ultraviolet fluorescences due to phenylalanine and tyrosine is accompanied by the concomitant appearance of new blue fluorescences excited at 350 mμ. Although the ultraviolet fluorescences of tyrosine and phenylalanine decrease uniformly with an increase in temperature, the intensity of the blue fluorescences shows an anomalous rise in the temperature range from 30 to 40°. This temperature range corresponds to that of a helix to random-coil transition as shown in the change of viscosity, optical rotation, and far-ultraviolet absorption. This transconformation temperature is lower in irradiated collagen than native collagen. The specific optical levorotation of irradiated collagen is greater than that of native collagen. Irradiated collagen is still able to form segment-long-spacing (SLS)-like aggregates, even though the ability to form native fibers is lost. These studies show that the blue fluorescences result from the photoproducts of phenylalanine and tyrosine. These photoproducts are probably integral parts of the new linkages. The blue fluorescences are dependent on the structural conformation of a helical rigid body which is not seriously damaged by radiation. (auth)

18253 STUDIES OF CHLOROPLAST DEVELOPMENT IN EUGLENA. XIV. SEQUENTIAL INTERACTIONS OF ULTRAVIOLET LIGHT AND PHOTOREACTIVATING LIGHT IN GREEN COLONY FORMATION. Hill, Helene Z.; Epstein, H. T.; Schiff, Jerome A. (Brandeis Univ., Waltham, Mass.). Biophys. J., 6: 135-44(Mar. 1966).

Photoreactivation (PR) of green colony-forming ability in Euglena is pH-insensitive from pH 6.0 to 8.0 and temperature-sensitive with a maximum rate at 35°C. There is no PR at 0°C. The rate of PR varies with the growth stage of the cells; PR of exponential phase cells is slower than that of stationary phase cells. The reciprocity rule holds for PR over a 6-fold range of intensity. The shape of PR curves is a function of the uv dose; there appears to be a progressive increase in multiplicity until a limiting multiplicity is reached as indicated by the fact that curves for high doses are superposable. Dark-grown and light-grown cells give the same PR response for comparable uv doses. Ultraviolet inactivation of cells which have been treated with uv and then with PR light shows that, if the PR dose is sufficiently large, the same uv-inactivation curve is obtained as for nonpretreated control cells. Doses of PR lower than the saturating dose produce uv-inactivation curves, the ultimate slopes of which are parallel to the slope of the control curve, but which show reduced multiplicity. The multiplicity of these curves increases with increasing PR dose. The uv inactivation of green colony-forming ability in Euglena is completely photoreactivable at the doses studied, in contrast with the uv inactivation of colony-forming ability, which occurs at considerably higher uv doses and behaves like most other photoreactivable systems, showing a photoreactivable sector of 0.32. (auth)

18254 SOME CHARACTERISTICS OF THE RESISTANCE TRANSFER FACTOR (RTF) EPISOME AS DETERMINED BY INACTIVATION WITH TRITIUM, ^{32}P, AND GAMMA RADIATION. Painter, Robert B.; Ginoza, Herbert S. (Ames Research Center, Moffett Field, Calif.). Biophys. J., 6: 153-62(Mar. 1966).

The resistance transfer factor (RTF) episome was studied by measuring its inactivation by ^{60}Co gamma radiation, by incorporated ^{32}P, and by tritium incorporated as tritium-labeled thymine. The D_{37} for ^{60}Co irradiation was 7 to 9×10^4 rad. Growth of the bacteria harboring the RTF in BUdR (bromouracil deoxyriboside) increased the sensitivity of the RTF to the gamma radiation. The RTF was markedly inactivated by tritium after growth of the host (thymine requiring) bacteria in tritium-labeled thymine, thus further establishing the presence of thymine in genome of the RTF. Assuming the efficiency of inactivation by ^{32}P to be 10%, the phosphorus content of the RTF was estimated to be about 2×10^5 P atoms/episome. The data suggest the RTF contains double stranded DNA with a molecular weight of the order of 3 to 8×10^7. (auth)

18255 KERATIN GRANULOMAS IN IRRADIATED SQUAMOUS CELL CARCINOMA OF VARIOUS SITES. Safall, Homa; Azar, Henry A. (Columbia Univ., New York. Francis Delafield Hospital, New York). Cancer Res., 26: 500-8(Mar. 1966).

An extensive foreign-body giant cell reaction around necrotic or degenerating keratinized tumor was observed in 20 instances of human squamous cell carcinoma of various sites and following external x-ray or radium therapy. The data presented suggest that radiation injury in squamous cell carcinoma may be manifested by marked hyperkeratinization of tumor cells. The keratin compounds that are liberated from injured tumor cells induce a severe foreign-body giant cell reaction as well as a mixed leukocytic reaction. In this material, the development of keratogenesis and keratin granulomas did not seem to have influenced the malignant potential of irradiated squamous cell carcinoma. (auth)

18256 ON THE INCREASE OF THE RADIOSENSITIVITY OF DESOXYRIBONUCLEIC ACID DEPRIVED OF PURIC BASES. Van De Vorst, Albert; Richir, Marc; Krsmanovic-Simic, Draga (Univ., Liege). Compt. Rend., Ser. D, 262: 401-2(Jan. 17, 1966). (In French).

By studying the evolution of free radicals induced by x radiation, it was shown that the elimination of purines from DNA causes a considerable increase in radiosensitivity. The spectra observed indicate a localization of the paramagnetic centers in cytosine. The analogy with results obtained in vivo with cultures of E. coli deficient in purines is discussed. (tr-auth)

18257 DECREASE OF THE SEROTONIN CONCENTRATION OF THE BLOOD IN THE IRRADIATED RABBIT. Nakamura, W.; Momma, H.; Eto, H. (National Inst. of Radiological Sciences, Chiba, Japan). Compt. Rend. Soc. Biol., 159: 1629-32(1965). (In French).

The whole-body irradiation of rabbits by a single x-ray dose of 500 or 1000 R caused, after a brief elevation phase, a decrease of the 5-hydroxytryptamine of the blood. The depression maximum was between the 8th and 13th day after irradiation. (tr-auth)

18258 EFFECTS OF SINGLE WHOLE-BODY X IRRADIATION ON THE GLYCOPROTEIN FRACTIONAL COMPOSITION OF BLOOD SERUM IN RATS. Oletskii, E. I. (Minsk Medical Inst.). Dokl. Akad. Nauk Belorussk. SSR, 9: 616-17(Sept. 1965). (In Russian).

Experiments on 106 white rats (170 to 200 g) x-irradiated with single whole-body doses of 700 R (20 R/min) showed the changes in blood serum glycoproteins at times of up to 120 days after irradiation. The albumin fraction changed insignificantly at first, but then decreased slowly to the 30th day, and became normal again at day 120. The α_1-glycoprotein was lower than normal for the whole 120-day period. The α_2-glycoprotein was considerably below normal the whole time. The β-glycoprotein was high after the 10th day and remained high until the end of the experiment. The γ-glycoprotein rose the first day, became very high after a month, and stayed high until the end of the experiment. The differences in response to irradiation of the different glycoprotein fractions may explain the different degrees of disruption of the metabolic processes of these fractions. (TTT)

18259 SCREENING OF MACROMOLECULES FROM LATENT RADIATION DAMAGE. **Eidus, L. Kh.; Otarova, G. K. (Inst. of Biological Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 171-4(Oct. 11, 1965). (In Russian).**

Radioinduced molecular damage was studied in solutions of γ-irradiated myosin to which ATP was added. It was suggested that under these conditions latent molecular damage in the albumin would not be converted to apparent damage. The experiments proved that in the presence of ATP, the activity of the intact albumin as well as nearly all the albumin with latent damage was not disrupted. However, the assumption that ATP might repair the latent damage was not confirmed. The screening effect of admixtures was produced because their molecules were absorbed on the albumin, preventing the partial expansion of damaged molecules in the second stage of inactivation. (H.G.D.)

18260 ON THE VARIATIONS IN DNA CONTENT IN CELLS OF AN IRRADIATED ORGANISM. **Dolgo-Saburov, V. B. (Kirov Military Medical Academy, USSR). Dokl. Akad. Nauk SSSR, 164: 1407-8(Oct. 21, 1965). (In Russian).**

Studies were conducted to determine changes in the liver DNA content of animals for which polyploidy is not characteristic. Guinea pigs whose liver cell population consists only of diploid cells were irradiated with a 300 R dose of x rays and sacrificed after one day. A weighed liver sample was used to determine: the gross amount of DNA; the number of cells per 1 gram of tissue; the DNA content in the cells; and the DNA content in the nucleus of the average cell. No DNA increase was observed in the healthy cells. Thus cells retaining their vitality in tissues equal in respect to radiosensitivity but differing in regard to ploidy react differently in regard to DNA content in the nucleus. It is assumed that the increased amount of DNA in the liver of irradiated rats is due to an increase of cells with a high degree of ploidy rather than to new DNA synthesis, and that this represents a regenerative process and depends on changes in the ploidy level. (TCO)

18261 ACTION OF X RAYS ON CYTOCHROME c IN VITRO. **Manoilov, S. E.; Derkachev, E. F. (Central Roentgeno-Radiological Research Inst., USSR. (Leningrad Inst. of Pharmaceutical Chemistry). Federation Proc., Transl. Suppl., 25: T121-2(Jan.-Feb. 1966).**

Translated from Vop. Med. Khim., 11: 95(1965).

The effects of x-radiation on cytochrome c were studied in preparations from normal and damaged cells. Absorption by irradiated cytochrome after reduction with ascorbic acid in the regions of 550-521 and 415 mμ was depressed compared with that of the untreated preparation. Uses of cytochrome c are discussed. (H.G.D.)

18262 ACTIVITY OF ACID AND NEUTRAL DESOXYRIBONUCLEASE IN THE URINE OF ALBINO RATS IRRADIATED BY NEUTRONS. **Khursin, N. E. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 11: 627-30 (1965). (In Russian).**

The activity of acid and neutral DNAse in the urine of white rats irradiated with neutrons at doses of 25, 100, and 400 rad was investigated. The activity of acid and alkaline DNAse was increased in the urine of rats irradiated with neutrons. The lowest neutron dose at which a marked increase of the activity was observed was in the range between 25 and 100 rad. The increase of the activity was observed at an early date after irradiation. The increase of the activity in the urine after neutron irradiation can be used for the early diagnosis of radiation injury. (tr-auth)

18263 MOLECULAR MECHANISMS OF LIVER REGENERATION. V. THE EFFECT OF X-RADIATION ON THE INCORPORATION OF ^{14}C-OROTIC ACID INTO RAPIDLY LABELED NUCLEAR RIBONUCLEIC ACID. **Uchiyama, Teruo; Fausto, Nelson; Van Lancker, J. L. (Univ. of Wisconsin, Madison). J. Biol. Chem., 241: 991-6(Feb. 25, 1966).**

Rapidly labeled nuclear RNA was extracted with phenol from normal and regenerating rat livers after ^{14}C-orotic acid injection. Highest specific activities were obtained 20 min after the injection of the precursor. When bentonite was used in the phenol extraction, the distribution of the radioactivity in the sedimentation profiles of the rapidly labeled nuclear RNA was modified. In presence of bentonite, the peak of radioactivity precedes the ultraviolet absorption peak of the RNA of highest molecular weight. After partial hepatectomy, the specific activity of the phenol-extracted, rapidly labeled nuclear RNA increases between 0 and 6 hrs and 12 and 24 hrs, but remains unchanged between 6 and 12 hrs after operation. The increase in specific activity is caused by an increase in the labeling of the RNA of highest molecular weight. Whole body doses of x radiation administered 6 hours prior to killing the experimental animals interfere with the incorporation of ^{14}C-orotic acid in the rapidly labeled nuclear RNA extracted from liver obtained 6, 12, 18, and 24 hours after partial hepatectomy. The effect of x radiation is more marked 18 and 24 hours than 6 and 12 hours after partial hepatectomy. Irradiation is without effect on the incorporation of ^{14}C-orotic acid into the rapidly labeled nuclear RNA extracted from normal livers. In normal or regenerating liver, x-irradiation does not modify the ultraviolet absorption profiles of the phenol-extracted, rapidly labeled nuclear RNA. (auth)

18264 THE SYNTHESIS OF DNA, RNA, AND NUCLEAR PROTEIN IN NORMAL AND TUMOR STRAIN CELLS. I. FRESH EMBRYO HUMAN CELLS. **Seed, John (Univ. of Cambridge, Eng.). J. Cell Biol., 28: 233-48(Feb. 1966).**

Interferometric and photometric measurements were made on replicating embryo human cell cultures. From a study of the relations between successive physical measurements on individual cells, it was found that the net syntheses of DNA, nuclear RNA, nuclear protein, and cytoplasmic RNA are closely associated during interphase. Additional measurements of DNA and cytoplasmic RNA on freshly prepared replicating monkey kidney cells gave similar results. In auxiliary experiments with embryo human cells, an inhibition of the onset of DNA synthesis (produced by a dose of x rays) was found to block the majority of the accumulation of nuclear protein and RNA and about half the accumulation of cytoplasmic RNA. These results are consistent with others previously reported in dividing cell cultures freshly prepared from normal tissues. (auth)

18265 THE SYNTHESIS OF DNA, RNA, AND NUCLEAR PROTEIN IN NORMAL AND TUMOR STRAIN CELLS. II. FRESH EMBRYO MOUSE CELLS. **Seed, John (Univ. of Cambridge, Eng.). J. Cell Biol., 28: 249-56(Feb. 1966).**

Interferometric and photometric measurements were made on replicating embryo mouse cell cultures. From a study of the relations between successive physical measurements on individual cells, it was found that the net syntheses of DNA, nuclear RNA, nuclear protein, and cytoplasmic RNA are closely associated during interphase. In auxiliary experiments, an inhibition of the onset of DNA synthesis (produced by a dose of x rays) was found to block the majority of the accumulation of nuclear protein and nuclear RNA. The results are consistent with others previously reported in dividing cell cultures freshly prepared from normal tissues. (auth)

18266 THE SYNTHESIS OF DNA, RNA, AND NUCLEAR PROTEIN IN NORMAL AND TUMOR STRAIN CELLS. III. MOUSE ASCITES TUMOR CELLS. Seed, John (Univ. of Cambridge, Eng.). J. Cell Biol., 28: 257-61(Feb. 1966).

Interferometric and photometric measurements were made on replicating mouse ascites tumor cell cultures. From a study of the relations between successive physical measurements on individual cells, it was found that whereas the net syntheses of nuclear RNA and nuclear protein are closely associated during interphase, they are dissociated from DNA replication to a significant extent. The results agree with others reported in replicating cell strains derived from tumors. In auxiliary experiments an attempt was made to block the initiation of DNA synthesis by x-irradiation: although large amounts of nuclear protein accumulated in some cells in the absence of DNA synthesis, the inability to hold the DNA block for an interphase time prevented a quantitative analysis of the results. (auth)

18267 THE SYNTHESIS OF DNA, RNA, AND NUCLEAR PROTEIN IN NORMAL AND TUMOR STRAIN CELLS. IV. HeLa TUMOR STRAIN CELLS. Seed, John (Univ. of Cambridge, Eng.). J. Cell Biol., 28: 263-75(Feb. 1966).

Interferometric and photometric measurements were made on HeLa cells, a strain of cells originally derived from a human carcinoma. From a study of the relations between successive physical measurements on individual cells, it was confirmed that, whereas the net syntheses of nuclear RNA and nuclear protein are closely associated during interphase, they are dissociated from DNA replication to a significant extent. The results on nuclear metabolism agree with others previously reported in cell strains derived from tumors; they contrast with results from freshly prepared normal cells, where the net syntheses of DNA, nuclear RNA, and protein are closely associated during interphase. Cytoplasmic measurements on HeLa cells showed that much of the net synthesis of cytoplasmic RNA is associated with DNA replication as in normal cells, and they failed to detect transfer from the nucleus of a stable RNA component synthesized independently from DNA replication. In auxiliary experiments, an inhibition of the onset of DNA synthesis was produced by a dose of x rays; under these conditions it was shown that the major part of the accumulation of nuclear protein was independent of DNA replication and that the accumulation of nuclear RNA was equivalent to or slightly less than that of nuclear protein. About half the accumulation of cytoplasmic RNA was inhibited when DNA synthesis was blocked. (auth)

18268 INACTIVATION AND INDUCTION OF ELECTRON SPIN RESONANCE-CENTRES IN TRYPSIN BY IONIZING RADIATION AND BY ULTRA-VIOLET LIGHT. Brustad, Tor (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Nature, 209: 31-2(Jan. 1, 1966).

A comparison was made between enzyme inactivation and the number of ESR centers induced in trypsin by gamma radiation and ultraviolet light. The dose-effect curves were exponential when trypsin was subjected to gamma rays, but were not when exposed to ultraviolet light. The shape of the ESR spectrum of radicals induced by ultraviolet light had many features in common with that of the gamma-induced centers. The peaks occurred at the same magnetic field strengths, but appeared to be somewhat better resolved in the latter case. There was a linear relation between the number of ESR centers induced by ultraviolet light and the corresponding inactivation. When exposed to gamma radiation the number of radicals per gram of trypsin increased rapidly with increasing inactivation, but saturation was approached after long exposure. (M.C.G.)

18269 REPAIR OF X-RAY DAMAGE TO THE DEOXYRIBONUCLEIC ACID IN MICROCOCCUS RADIODURANS. Dean, C. J.; Feldschreiber, P.; Lett, J. T. (Royal Cancer Hospital, London). Nature, 209: 49-52(Jan. 1, 1966).

Some of the changes that occur in the DNA of Micrococcus radiodurans following x-irradiation are described. Stirred samples of growing cells were irradiated at 4°C under nitrogen with 220-kv x rays at a dose rate of 1.1×10^4 rads/min. The DNA was extracted to a yield of 50 to 80%. There was a considerable decrease in viscosity of the DNA from irradiated M. radiodurans and the extent of the decrease was dose dependent. It was concluded that M. radiodurans DNA is about 25% more resistant to x-ray-induced double breaks than the DNA of E. coli when irradiated in vivo. The apparent increased radiosensitivity of DNA in vivo may be due to a large contribution by indirect action or to energy transfer from the proteins associated with the DNA. However, it can also be explained as another result of hydrodynamic shear. The DNA exhibited considerable damage at doses where the cells exhibited 100% survival. During post-irradiation growth the cells repaired lesions in DNA. Mechanisms for this process are suggested. (M.C.G.)

18270 RADIATION EFFECTS ON THE DNA SYNTHESIS IN TUMOR CELLS. Maass, H.; Schulz, K.-D. (Univ., Hamburg). Nucl.-Med., Suppl. 3, 111-18(1965). (In German).

Comparative investigations made of cellular kinetics in two Ehrlich ascites carcinoma strains by ^{14}C-thymidine introduction into the DNA and of the DPN concentration after x irradiation gave significant variations in the radiosensitivity of the two strains. After 2000 and 5000 R in the radiosensitive strain, there is an immediate stopping of the cell growth independent of the time point of the generation cycle in which the cells are irradiated. The radioresistant strain completes one or two cell divisions undisturbed, whereas in the radiosensitive strain a significant inhibition of the DNA synthesis is found when the irradiation of the cells occurs during the S phase. The DNA multiplication phase of the radioresistant strain is still not inhibited after 2000 R. However, there is probably a disturbance in the G_1 phase. A strong inhibition of the DNA synthesis rate is found principally when the irradiation occurs in the preceding interphase. The DPN concentration remains unaltered in both strains and at all times after the irradiation. (tr-auth)

18271 EFFECT OF IONIZING RADIATION ON THE INTRODUCTION OF TRITIUM-LABELED THYMIDINE IN YOSHIDA SARCOMA OF THE RAT. Feine, U. (Univ., Tuebingen, Ger.). Nucl.-Med., Suppl. 3, 119-26(1965). (In German).

Both in irradiated Yoshida sarcoma and in irradiated normal tissue a significant inhibition of the tritiated-thymidine uptake and, consequently, an inhibition of the DNA synthesis is established. The ^3H-thymidine uptake was reduced 35% at 800 R. The determination of the granular number over the nucleus of the irradiated cells shows that there is a uniform reduction of the granular number over all labeled cells both in the solid tumor and in its ascites form. There is a simultaneous reduction of the DNA synthesis when a given part of the cell cycle, such as the presynthetic G_1 phase, was responsible for the DNA synthesis inhibition. On the basis of the present and previous studies, it was concluded that a DNA synthesis inhibition was caused by an ionizing radiation during the entire synthesis phase. Studies on the normal tissues of the duodenum with determination of the cell cycle have confirmed the results obtained on tumor tissues. (tr-auth)

18272 RESISTANCE OF RATS TO SEVERE OXYGEN DEFICIENCY DURING RADIATION SICKNESS. Gasteva, S. V.; Ivanov, K. P.; Chetverikov, D. A. Probl. Kosm. Biol., 4: 437-44(1965). (In Russian).

Experiments were conducted to determine the effect of ionizing radiation on oxidizing systems in living tissues by showing whether the resistance of rats to acute hypoxia changes in the course of severe radiation sickness. Male rats weighing 200 to 250 g were subjected to a dose of x-rays (750 R) sufficient to cause mass death 80 hours after irradiation. Immediately after irradiation, and then at intervals of 3, 6, 12, 24, 48, 72, and 96 hours, groups of experimental and control rats were placed in an altitude chamber and subjected to rarefied atmosphere (140 mm Hg). The resistance of irradiated rats to hypoxia, evident 6 hours after irradiation, was most pronounced after 72

hours. In order to determine whether a decrease in the intensity of metabolic processes is the chief cause of resistance to hypoxia, the rectal temperature and oxygen consumption of irradiated rats were measured in the designated time intervals. The absence of essential changes in these indices showed that the decrease in the intensity of metabolic processes in irradiated rats is not the sole cause of increased resistance to hypoxia. Another series of experiments tested oxygen consumption of animals directly under hypoxic conditions. Gas-exchange studies under normal atmospheric and hypoxic conditions were compared, and it was concluded that the mechanism of increased resistance to hypoxia is different at different stages of radiation sickness. Further research is needed to determine the exact causes of increased resistance at different times. (TCO)

18273 THE REACTION OF HYDROGEN ATOMS WITH THYMINE AND DNA. **Heller, H. C.; Cole, T. (Ford Motor Co., Dearborn, Mich.). Proc. Natl. Acad. Sci., 54: 1486-90(Dec. 1965).**

Experiments were performed to determine whether specificity in the reaction of thermal hydrogens was attainable in DNA and its constituent bases. High-purity thymine and calf thymus DNA were bombarded with hydrogen atoms produced by an electrodeless discharge in a flow system. Results confirm beyond doubt that the thymyl radical is indeed formed by the addition of a hydrogen atom to carbon (6) of thymine, and that its formation does not require uv or high-energy radiation. The two methylene protons in the radical appear to be inequivalent. Radicals (unidentified as yet) are also formed in DNA subjected to hydrogen atom bombardment. It is suggested that, inasmuch as hydrogen atoms appear to be important intermediates in the photo- and radiation damage of biological compounds, the present technique of hydrogen atom bombardment may help to elucidate secondary reactions involved in such damage. (H.G.D.)

18274 RADIATION DAMAGE ON THE MOLECULAR LEVEL AND ITS MODIFICATION. **Pihl, A.; Sanner, T. (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Progr. Biochem. Pharmacol., 1: 85-98(1965).**

Radioprotection and radiosensitization are discussed in terms of factors influencing radiation inactivation of molecules. Electron spin resonance studies are reported on the transfer of unpaired spins from mononucleotides to cysteamine in the dry state. The results indicate that sulfur atoms have a remarkable ability to trap radiation energy in a presumably non-deleterious way. Data are presented indicating that reduced pyridine coenzymes may be efficient hydrogen donors. Sulfhydryl compounds protect against x ray inactivation in solution and in the dry state. The significance in biological systems of the different protective mechanisms is considered. (44 references.) (auth)

18275 THE EFFECT OF SUBSTITUTION OF THYMINE BY BROMO-URACIL ON PRIMARY RADICAL FORMATION IN DNA. **Ormerod, M. G. (Royal Military Coll. of Science, Swindon, Eng.). Progr. Biochem. Pharmacol., 1: 137-41(1965).**

ESR studies of γ radiation induced radical formation give no reason to believe that free radicals are formed preferentially on the thymine nucleotide in DNA. Substituting for 44% of the thymine in DNA by bromouracil increases primary radical formation by about 30% which is insufficient to account for the radiosensitization observed in in vivo systems. This suggests that radiosensitization by halo-uracil substitution in DNA is not predominantly a chemical effect but a biological one. (auth)

18276 MERCAPTAN-DISULFIDE INTERCHANGE AND RADIOPROTECTION. **Gorin, G. (Oklahoma State Univ., Stillwater). Progr. Biochem. Pharmacol., 1: 142-51 (1965).**

Chemicals of diverse types have been found to exert some protective effects against radiation injuries in living organisms. 2-Aminoethanethiol (cysteamine) and some related aminomercaptans constitute the group that seems to offer the greatest promise. Results are reported from a study of the possible role of mercaptan-disulfide interchange reactions in the mechanism of protection by these compounds in simple organic systems. Results indicate that the addition of suitable mercaptans and disulfides to solutions of proteins in vitro reduced the amount of radiation damage. Several hypotheses concerning the mechanism of protection are discussed. (C.H.)

18277 BIOCHEMICAL RESPONSES OF PLANT SYSTEMS TO LARGE DOSES OF IONIZING RADIATION. **Romani, R. J. (Univ. of California, Davis). Radiat. Bot., 6: 87-104(Apr. 1966).**

Cytoplasmic responses of plant tissues to ionizing radiation are reviewed, and the utility of large radiation doses as tools for biochemical research are explored. Because the concomitant effects of radiation on the plant tissues have often been interpreted in food technological or plant physiological terms, experiments using doses in the range of 0.1 to 1 Mrad to control pathogens on fruits and vegetables are included. A brief synopsis of recent papers on fruit and vegetable irradiation serves as an introduction to the types of responses observed at high doses. (H.G.D.)

18278 EFFECTS OF SINGLE AND DIVIDED DOSES OF RADIATION ON LABELED THYMIDINE INCORPORATION INTO DNA. **Looney, W. B.; Chang, L. O. (Univ. of Virginia, Charlottesville). Contract AT(40-1)-2889. Radiology, 86: 457-62(Mar. 1966). (TID-22495).**

The effects of single and divided doses of radiation on DNA synthesis in vivo were evaluated over a 256-minute time interval both in liver cells synchronized by partial hepatectomy and in asynchronous intestinal cells following localized irradiation. Labeled thymidine incorporation into DNA was used as an index for the effects of radiation on DNA synthesis. Divided doses of 375 R × 2 and 750 R × 2 were compared with single doses of 750 R and 1,500 R. The spacing of the time between radiation doses up to 4 minutes caused less depression of DNA synthesis than spacing 4 minutes or more. The second part of the divided dose up to 4 minutes seems less efficient in causing increased depression; however, the 4-minute interval seems to be the optimum time for spacing the divided doses at a given total dose for the major depression. Little additional depression takes place by extending the time between doses from 4 to 256 minutes. The principal depression of DNA synthesis following a single dose of radiation also occurred during the first few minutes. The characteristics of the response to radiation in liver and intestines were similar; however, the magnitude of the depression was greater initially in the intestines. (TCO)

18279 INFLUENCE OF DEOXYRIBONUCLEIC ACID EXTRACTED FROM NORMAL AND IRRADIATED TISSUES ON THE ACTIVITY OF HEPATIC CATALASE. I. **Furnica, M.; Popa, E.; Popovici, O. (Institut Oncologique, Bucharest). Rev Roum. Biochim., 2: 133-8(1965). (In French).**

Native DNA, extracted from normal rats liver results in a 35% activation of hepatic catalase, while that extracted from irradiated rats liver (1,000 R) results in a 92% activation. Native preparation, denatured with urea, reduced 20% the catalase activity. The commercial preparation has no influence on catalase activity. It seems that action of native DNA on catalase is linked to the presence of the nondenatured macromolecule. The difference between the DNA extracted from the normal tissue and of that from the irradiated one cannot be accounted for by the different contents of Cu^{2+} or Fe^{3+}. (auth)

18280 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. PART 67. THE ACTIVITY OF GLUTAMIC-OXALACETIC TRANSAMINASE AND GLUTAMIC DEHYDROGENASE IN SPLEEN TISSUE AFTER WHOLE-BODY IRRADIATION AND POSSIBLE RELATIONS TO MORPHOLOGICAL CHANGES. **Streffer, Christian; Melching, Hans-Joachim (Univ., Freiburg i. B.). Strahlentherapie, 129: 282-94(Feb. 1966). (In German).**

Glutamic-oxaloacetic transaminase and glutamic dehydrogenase activities, the protein content of the soluble cytoplasm fraction, and splenic tissue particles were determined after whole-body irradiation of white mice. In the particulate fraction a decrease in all three values was observed. This decrease is especially large between the 2nd and 7th day after irradiation with 690 R and is followed by a regeneration period from the 8th day. The first significant changes were observed one day after irradiation with 150 R. Irradiations with doses from 400 to 810 R resulted in the same initial effect. Present results are discussed and compared with morphological results obtained by other investigators. (auth)

18281 STUDIES IN WOOL YELLOWING. PART X. EFFECT OF SUNLIGHT IRRADIATION IN THE PRESENCE OF TRITIATED WATER. Leach, S. J.; Holts, L. A. (C.S.I.R.O., Melbourne). Textile Res. J., 35: 380-1(Apr. 1965).

Irradiation of wool with uv light (the most active component of sunlight on wool) causes changes in color and amino acid composition. Some indication of the nature of the primary events is obtainable by irradiating wool in the presence of deuterium or tritium gas or their oxides. Thus, the energy required to dissociate a hydrogen atom is within the range that could be supplied by uv irradiation. Isolation of isotopically labeled fragments was attempted to permit identification of the points at which irradiation produces dissociation. Samples of wool fabric were sealed in 1-cm quartz cuvettes, in the presence of tritiated water (1 C/ml, 200 μl), and exposed to sunlight for 14 days at 38°C. Chromatography of amino acids after hydrolysis of wool kept in darkness or exposed to sunlight revealed that with concentrated tritiated water at 38°C, exchange at carbon sites can occur even without irradiation. Lysine was mainly affected and cystine and histidine to a lesser extent. Sunlight promoted exchange at carbon sites, mainly at cystine residues, with lysine affected to a lesser extent, and aspartic acid, glycine, and proline to a still smaller extent. Tryptophan, which is affected on irradiation of wool fabric, was destroyed during acid hydrolysis; hence, any irreversible tritium incorporation in it could not be determined under these conditions. The results supported the viewpoint that cystine is one of the initial points of attack during the sunlight irradiation of wool; however, the replacement of hydrogen atoms at any site, while requiring C–H bond rupture, need not necessarily be followed by secondary reactions leading to amino acid destruction. (BBB)

18282 THE EFFECT OF AN ANTIGEN-ANTIBODY COMPLEX ON NORMAL AND IRRADIATED ANIMALS. Kaulen, D. R.; Tatushina, M. A. (Gamelin Inst. of Epidemiology and Microbiology, Academy of Sciences, USSR). Zh. Mikrobiol. Epidemiol. Immunobiol., No. 1, 130-4(Jan. 1966). (In Russian).

A study was made of the effect of a soluble antigen-antibody complex on normal and irradiated mice. Irradiation (100 to 700 R) either failed to change or somewhat reduced the animal sensitivity to the complex. The sensitivity of nonvaccinated mice to the antigen-antibody complex expressed a marked rise when those mice were irradiated. (auth)

Radiation Effects on Tissues

Refer also to abstracts 18993, 20341, and 20342.

18283 (AD–611869, pp 375-89) THE EFFECTS OF MASSIVE DOSES OF IONIZING RADIATION UPON CONDITIONED AVOIDANCE BEHAVIOR OF THE PRIMATE. Sharp, Joseph C.; Brady, Joseph V. (Walter Reed Army Inst. of Research, Washington, D. C.).

Results are reported from a study to investigate how a relatively simple, highly motivated task that requires periodic response is affected by massive and acute doses of whole-body radiation. Monkeys (Macaca mulatta) were trained before exposure to 10,000 R x radiation to the head. Observations on general behavior and results of performance tests led to the conclusion that complicated or intricate motor manipulations will be severely attenuated by radiation; the shock avoidance paradigm is a powerful motivator and probably should continue to be used in preference to other forms of motivation for animal experimentation in behavioral radiology; the use of behavioral indexes will result in a more valid and pragmatic evaluation of the role of ionizing radiations in military and civil defense situations; the techniques of long-term behavioral control and the quantitative nature of the recorded behavior are valuable new tools for behavioral radiology; much more work on the effects of massive and acute doses of ionizing radiation on behavior is necessary; and the radioprotective effects of psychological stress should be carefully explored. (C.H.)

18284 (AD–629512) X-RAY-INDUCED GLOMERULOSCLEROSIS IN RATS: MODIFICATION OF LESION BY FOOD RESTRICTION, UNINEPHRECTOMY, AGE. Wachtel, L. W.; Cole, L. J.; Rosen, V. J. Jr. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 11, 1966. 24p. (USNRDL-TR–977).

The development of glomerulosclerosis was measured in the kidneys of rats under various conditions of x irradiation and growth. Weanling rats whose kidneys were irradiated directly with 1,000 rad or 2,000 rad developed glomerulosclerotic lesions in 2 months; one-year old rats showed no evidence of lesions 2 months after irradiation with 2,000 rad. In the weanling rat the rapidity of development and severity of the glomerulosclerotic lesions were increased by growth or enlargement of the kidney subsequent to irradiation, and were slowed by growth retardation artificially produced through low-food intake. The induction of glomerulosclerosis by x irradiation of the kidney is believed to be a latent result of damage to the kidney's vascular system, and that effects of this damage are accentuated in the growing kidney. (auth)

18285 (AD–630103) EFFECTS OF TOTAL-BODY X IRRADIATION ON PERITONEAL AND CIRCULATING LEUKOCYTES OF MICE. Kornfeld, L.; Greenman, V. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 13, 1966. 22p. (USNRDL-TR–966). CFSTI $1.00 cy, $0.50 mn.

Total-body x irradiation over a wide range of doses was found to alter the number and distribution of cells in the peritoneal cavity of unstimulated LAF_1 mice. Unirradiated controls yielded 5 to 7×10^6 mononuclear cells, about 30% of which were macrophages and 70% small and medium lymphocytes. Following exposure to sublethal x ray doses (90 to 590 R), macrophage counts were essentially unaltered for two weeks but declined slightly during the 3rd week after 390 to 590 R. Following a midlethal dose (690 R), the number of macrophages was unchanged for one week but fell to about 50% of the normal value by 21 days postirradiation. After lethal irradiation (790 to 1190 R), macrophage counts remained unaltered for 3 days but decreased on the 7th day. The number of lymphocytes in the peritoneal cavity decreased sharply within 24 hours after every dose employed and then declined further at a more gradual rate. Both the initial and the subsequent disappearance of lymphocytes increased in severity with increasing exposure. During the first week postirradiation, a linear relation existed between the percentage of lymphocytes in the peritoneal cell population and the x ray dose. After exposure to a given dose, the loss of lymphocytes was several-fold greater in the peripheral blood than in the peritoneal cavity. However, the disappearance rate of circulating lymphocytes was essentially like that of small peritoneal lymphocytes. The medium lymphocytes in the peritoneal cavity were affected to a significantly lesser extent. (auth)

18286 (EUR–2462.f) THYMECTOMIE ET RADIOCANCERS. CARYOTYPE NORMAL, ANOMALIES CHROMOSOMIQUES APRES THYMIDINE TRITIEE CHEZ LES SOURIS C57 BL/6. (Thymectomy and Radiocancers. Normal Karyotype, Chromosomal Abnormalities After Tritiated Thymidine in the Mouse C57 BL/6). Mewissen,

D. J.; Lagneau L. E. (Brussels Univ. (Belgium). Institut Jules Bordet). Mar. 17, 1965. 12p. Dep. mn.

The incidence of tumors late-induced by x rays was studied in C57 BL/6 mice which had undergone thymectomy and irradiation and then, in some cases only, grafting of an isogenic thymic lobe. Thymectomy has the effect not only of reducing the incidence of lymphosarcoma, but also that of numerous other tumors, notably hepatomata. The karyotype of C57 BL/6 mice is marked by forty chromosomes and very few spontaneous aberrations. At least six pairs are not telocentric, while another pair contains a bilocular chromosome. In the mitotic chromosomes of C57 BL/6 mice injected at birth with thymidine tritiated with doses ranging from 0.5 to 2.0 mC/g, achromatic vesicular images are observed which are not superposed on the tritiated molecules detected by autoradiography. (auth)

18287 (EUR–2638.i) ESCREZIONE DI GLUCURONIDI URINARI NEL RATTO IRRADIATO. (Glucuronide Excretion in the Urine of Irradiated Rats). Scoppa, P.; Gerbaulet, K. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1966. 10p. (CONF-650967–1). Dep. mn.

From Italian Society of Experimental Biology, 34th General Assembly, Sorrento, Italy.

The urinary excretion of total glucuronides is strongly reduced in the rat exposed to sublethal x radiation. The decreases of urinary glucuronides are examined and compared with those found in paired feed controls. (auth)

18288 (LA-3432) BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION. Annual Report, July 1964 Through June 1965. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 1965. Contract W-7405-eng-36. 267p. Dep. mn. CFSTI $6.00 cy, $1.50 mn.

Separate abstracts were prepared for five sections of this report. A list is included of publications during the period covered. (C.H.)

For abstracts of individual sections see: 18186, 18203–18205, and 18289.

18289 (LA–3432, pp 56–101) MAMMALIAN RADIOBIOLOGY SECTION. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

Data are presented from a radiation genetics program to study heritable effects of x ray exposure to consecutive generations of mice has been continued through the 35th generation. Data are presented on the comparative breeding characteristics of offspring of the 25th generation; the radiation resistance of mice from an x irradiated line to continuous exposure to ^{60}Co γ radiation at 4 to 5 rads/hr; a spontaneous mutation for a recurring hairless condition; hemoglobin molecular characteristics of mice exposed to x radiation for 32 consecutive generations; and comparative hematological and blood chemistry studies of mice exposed to x radiation for 32 generations. Report No. 29, "Exposure to Radiation in an Emergency," by the National Committee on Radiation Protection and Measurements, recommends the Effective Residual Dose (ERD) concept of radiation injury and recovery in planning exposure to gamma rays for critical personnel. Although the ERD concept is not a departure from present knowledge of radiation effects on man or animals, its validity has not been tested experimentally. The need is obvious, and pertinent investigations are in progress on mice, monkeys, and dogs. Results are reported from a preliminary study using approximately 200 RF strain virgin female mice 90 ± 7 days of age to test the first ERD model. Assumptions used with this model are as follows: (a) radiation-induced damage is linear with dose, and recovery is exponential; (b) recovery rate is independent of prior radiation exposure history or size of dose; (c) approximately 5 percent of any gamma-ray exposure is irreparable; and (d) the slow reparable component of radiation-induced injury has a repair half-time (RT_{50}) of approximately 7 days. The accuracy of these assumptions is not known, but they are based on the best experimental data available on this strain of mouse. Results are reported from a study of the residual irreparable damage (if any) to erythropoiesis in mice from whole-body gamma-ray exposures to single acute and second doses of 200, 400, 600, or 800 rads to a total dose of 1000 rads delivered in two acute fractions separated by 90 days of repair. Data are included from a study of the suitability of phencyclidine hydrochloride as a general anesthetic for laboratory primates and extraction techniques for mandibular and maxillary cuspids of Macaca mulatta and Macaca speciosa. (C.H.)

18290 (N–65–16483) ENERGY DISSIPATION CHARACTERISTICS IN TISSUE FOR IONIZING RADIATION IN SPACE. Progress Report No. 3, June 1–August 31, 1963. Schaefer, Hermann J. (Naval School of Aviation Medicine, Pensacola, Fla.). [1963]. 2p. (NASA-CR–51826). CFSTI $1.00 cy, $0.50 mn.

A method for improving the resolution of the linear energy transfer (LET) spectrum of heterogeneous proton beams at the upper end of the LET scale is described. The spectrum analysis covers the entire LET range of protons. Application was confined to one typical flare-produced proton spectrum (2g/cm^2 and 8g/cm^2) for the watt spectrum of neutron recoil protons. Results show that though the fractional dosage effected at LET values about the Bragg peak generally remains at a few percent of the total ionization dosage, it changes markedly depending on the depth in tissue analyzed. Consequently, a complete measurement of the radiation load from a solar proton beam requires separate determination of total dosage and of the second maximum at the upper end of the LET scale. (STAR)

18291 (N–65–17058) PHYSIOLOGICAL EFFECTS OF WEIGHTLESSNESS AND SPACE RADIATION ON HIBERNATORS. Semiannual Status Report No. 2. Musacchia, X. J. (Saint Louis Univ., Mo.). June 1963. 5p. (NASA-CR–50546). CFSTI $1.00 cy, $0.50 mn.

Irradiation of ground squirrels and hampsters with cobalt-60 facility is reported. The facility is described in detail. Also reported are the autoradiographic and other cytochemical techniques employed in regeneration of intestinal epithelium. Mitotic activity is localized in the basal layer of cells in the turtle intestinal epithelium. Mitosis duration is estimated at 2 hours in the turtles maintained at 20° to 24°C. Complete renewal of cell population of the intestinal epithelium takes about 8 weeks. Mitotic activity in cold torpid turtles is suppressed and its reactivation upon warming the animals is retarded. Also, hibernating ground squirrels subjected to 2000 R of x-irradiation demonstrated decreased concentrations of catecholamines. (STAR)

18292 (N–65–17068) INVESTIGATION OF THE EFFECTS OF IONIZING RADIATION ON THE CENTRAL NERVOUS SYSTEM IN VIVO AND IN VITRO. Quarterly Progress Report No. 1, July 16–October 18, 1963. Meigs, J. Ralph (Lockheed-California Co., Burbank. Biophysics Research Div.). [1963]. Contract NASw-787. 5p. (NASA-CR–52231). CFSTI $1.00 cy, $0.50 mn.

An investigation of the effects of ionizing radiation on the central nervous system in vivo and in vitro was conducted. Included are both technological progress and experimental progress in studying the effects of ionizing radiation on the central nervous systems of x-irradiated rats and cats, and in studying the electrical characteristics associated with neurophysiological processes of neurons and neuroglia in tissue culture, and the subsequent effects of ionizing radiation. (STAR)

18293 (NP–14898) AN ATTEMPT TO CORRELATE QUANTITATIVELY THE CHANGES IN PERMEABILITY OF MAMMALIAN MUSCLE CELLS WITH THE RADIATION DOSE. Final Report. Hashish, S.; Sallam, F.; El-Shafei, A. (Atomic Energy Establishment, Inshas (Egypt). National Research Centre, Cairo (Egypt)). [nd]. Contract 96. 55p. Dep. mn.

The effects of γ and x radiation on muscle physiology were studied in isolated rat diaphragm muscle-phrenic nerve preparations. Potassium-42, ^{86}Rb, and ^{24}Na were used as tracers for quantitative determinations of cell

membrane permeability, the effects of radiation on ionic fluxes and content in muscles, and the relationship of ionic content to muscle contractions. The muscles were indirectly stimulated through the nerve by a succession of maximal single shocks from a stimulator giving a rectangular wave with a constant current output. The isotonic contractions were recorded by means of a simple spring loaded lever and smoked paper on a slow drum. The muscles were maintained in modified Krebs solution at a constant temperature of 38°C. Data are presented on the inulin space and K, Na, and water contents of fresh and soaked rat diaphragm; intracellular ion concentrations; ionic flux in normal muscles; the kinetics of the uptake and loss of ^{42}K, ^{24}Na, and ^{86}Rb; the effects of heparin and histamine on ionic fluxes; and the isotonic contractions of normal and irradiated muscle preparations. Doses of γ or x radiation up to 100,000 R had no detectable effects on the water and ionic content, ionic flux, or muscle contraction in vitro. Reasons for this behavior are discussed. (48 references.) (C.H.)

18294 (TID–22766) SPECIALIZED RESPONSES TO IONIZING RADIATION. Second Year Progress Report, May 1, 1965–April 30, 1966. Shaber, Gary S. (Jefferson Medical Coll., Philadelphia, Pa.). Contract AT(30-1)-3359. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The technique of immunofluorescence was studied and a pilot experiment was carried out in rats to determine the specificity of antifibrinogen serum. The effects of whole-body x irradiation, with and without epsilon amino caproic acid treatment, on fibrinogen deposition in rats was studied using ^{131}I-fibrinogen and whole-body counting, tissue radioassay, and autoradiography. Preliminary studies were made to determine if tumorcidal doses of radiation could be obtained with ^{131}I-fibrinogen combined with external radiation. Results indicate that the apparent whole-body turnover time of fibrinogen becomes progressively prolonged with increasing doses of whole-body radiation and that fibrinogen leaves the vascular space after whole-body irradiation and that epsilon amino caproic acid enhances the in vivo selective deposition of fibrinogen in liver, kidneys, spleen, pancreas, skin, and salivary glands. A taste threshold measuring device was constructed and the taste thresholds for glucose were determined before and after exposure of the tongue to 50 rad irradiation. A preliminary study on hypothalamic self-stimulation rates following head irradiation failed to reveal any significant changes in the taste response of rats exposed to doses of 300 to 1800 R head irradiation. (C.H.)

18295 (UCLA–12-576, pp 27-56) RADIOBIOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Progress is reported in studies on the site of attack in the radiolysis of pyrimidine compounds; the development of a new ESR technique for studies of reactions of hydrogen atoms with organic compounds; the effects of 5-bromouracil incorporation on the γ radiosensitivity of Escherichia coli; the effects of γ radiation on cysteine in aqueous solution; the radiation chemistry of polynucleotides; the effects of estrogens on lipid metabolism in chickens; the inhibition of atherosclerosis in monkeys by chondriotin sulfate A, an acid mucopolysaccharide; the structure of myelin in rats irradiated to the brain only and retardation of myelin synthesis in irradiated animals; the effects of 750 R x radiation administered to the head of newborn rats on enzyme activity and protein synthesis in the developing brain stem; the effects of enzymes on lipid metabolism in chickens; cytoplasmic control of macronuclear DNA synthesis in Stentor coeruleus; ^{59}Fe tracer studies of erythropoietic activity in spleen colonies arising following the injection of bone marrow into lethally irradiated mice; the manipulation of oxygen pressure and concentration in atmosphere to study erythropoiesis in animals; the effects of radioactive mercurial diuretics, chlormerodrin-^{203}Hg and mercuhydrin-^{200}Hg, on the life span and kidney function of rats as measured by response to salt stress. (C.H.)

18296 (UCLA–12-576, pp 57-60) PHARMACOLOGY AND TOXICOLOGY. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

The content of steroids in the blood of burros was measured after whole-body and body-only exposure to fast neutrons. Early indications of adrenal response suggest that some peripheral influence must have initiated the response. Studies on the effects of adrenaline and noradrenaline on the peripheral vascular bed in the cat are reported. (C.H.)

18297 (UCLA–12-576, pp 81-8) BIOPHYSICS. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

The design of an improved electrophoretic cell separator is reported. Size distribution measurements were made in cultures of mixed human blood. Factors affecting the radiosensitivity of Neurospora crassa were studied. (C.H.)

18298 (UH–235P5-1, pp 39-46) EFFECT OF GAMMA IRRADIATION ON MANGO FRUITS AND MANGO SEED WEEVIL (STERNOCHETUS MANGIFERAE FEBRICUS). Upadhya, Mahesh D.; Brewbaker, James L.; Macion, Eduardo A. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Studies were conducted to determine the dose of gamma radiation necessary to completely kill seed weevils in mango fruits and the effects of these doses on the fruit. Preliminary results on two mango varieties indicated that the effective killing dose for seed weevils was between 30 and 60 krads. Fruits of some varieties were damaged at above 60 krads. (H.G.D.)

18299 (UH–235P5-1, pp 47-51) PRELIMINARY STUDIES ON THE EFFECT OF GAMMA IRRADIATION ON PINEAPPLE. Brewbaker, James L.; Upadhya, Mahesh D.; Macion, Eduardo A. (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Studies were initiated to evaluate the tolerance of fresh pineapple to different doses of gamma irradiation. The fruits were treated with doses of 25, 50, 120, 150, 300, and 600 krads and stored for one and two weeks at 40 to 42°F. Discoloration and flavor changes were observed after the 300 and 600 krad doses. Results indicated the desirable dose range to be under 120 krads. It was concluded that the variety tested, Smooth Cayenne, is radiosensitive. (H.G.D.)

18300 (UH–235P5-1, pp 55-74) SHELF-LIFE EXTENSION OF PAPAYAS WITH GAMMA IRRADIATION. Akamine, Ernest K.; Wong, Roland (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

Papaya fruits in various stages of ripeness were γ-irradiated at varying doses and stored at room temperature. The minimum tolerance dosage for papayas was found to be limited by the development of surface scalding, approximately 100 krad. Surface coloring progressed normally with storage up to about 200 krad. However, the softening of the pulp was delayed so that the pulp remained firm in fruits fully colored and edibly ripe. Further tests indicated that 75 krad was sufficient to retain firmness in papayas at the edible ripe stage. (H.G.D.)

18301 OXYGEN UPTAKE AND AMMONIA RELEASE IN NORMAL AND γ-IRRADIATED EGGS OF BOMBYX MORI. Lassota, Zofia (Inst. of Biochemistry and Biophysics, Warsaw). Acta Biochim. Pol., 12: 369-77(1965).

The rate of postdiapausal respiration in normal eggs of Bombyx mori was correlated with the developmental rate. The enhancement due to temperature involved mainly later stages, beginning with blastokinesis. Radiation doses inhibiting completely hatching, did not cause immediate death of the eggs. Respiration of irradiated eggs was blocked after 200 kR at the stage corresponding to blastula, and after 20 kR at that corresponding to late gastrula. The increase in respiration of 20 kR irradiated eggs was delayed. The delay, but not the final effect, depended on the temperature and on time interval between irradiation and incubation. Neither in irradiated nor in normal eggs could the release of NH_3 be stated. (auth)

18302 INVESTIGATIONS INTO THE RADIATION RESISTANCE OF TRIBOLIUM CONFUSUM (DUVAL) AND TYROPHAGUS DIMIDIATUS (HERMANN). Farkas, J. (Central Food Research Inst., Budapest). Acta Biol. Acad. Sci. Hung., 16: 207-15(1966).

Radioresistance of flour beetles was examined in the dose range 3 to 50 Krads. Survival times correlated with 25 and 50 per cent mortality were established as a function of radiation doses. The lethal effect of irradiation increased between the doses 6 and 12 Krads abruptly, while doses over 12 Krads raised the speed of beetle mortality only to a small degree. To sterilize adults and eggs radiation doses of 3 to 6 Krads were needed. Accordingly, insect eggs resistant to eradication by gas are highly sensitive to x rays. Radiation resistance of larvae is not higher than that of adults either; therefore products can be perfectly disinfested by lethal doses established for adults. It was also examined, whether the survival of flour beetles was affected or not by relative humidity prevailing in afterbreeding subsequent to radiation applied in doses of 25 Krads. Differences of LT_{50} values belonging to different levels of relative humidity were examined by variance analysis and the results thus obtained showed that the mean survival times observed under 30 and 90 per cent relative humidity and corrected with the mortality rate of control populations were significantly shorter than values belonging to 70 per cent relative humidity. Deviations in the mean survival time, however, are practically not important, because differences in LT_{50} values remained always below 25 per cent. Radiation resistance of mites was investigated in the dose range of 25 to 300 Krads and proved to be higher than that of beetles, but with doses of 25 to 50 Krads the reproduction of mites could also be inhibited. (auth)

18303 EFFECTS OF RADIOACTIVE STRONTIUM ON THE HARVEST OF AGRICULTURAL PLANTS IN LIME SOIL. Kedrov-Zikhman, O. K.; Egorova, T. K.; Zhelnova, V. K.; Bazegskii, E. P.; Artem'eva, L. I.; Prokhozov, N. S. Agrokhimya, 1: 113-22(1966). (In Russian).

The addition of lime to acid peat-podzolic soils significantly decreases the uptake of radioactive Sr by 100 g quantities of barley, red clover, alfalfa, white mustard, flax, carrots, and beets, but with respect to all harvests, the radioactivity is decreased or increased as a function of the biological characteristics of the plants and the conditions in which they are cultivated. The principal fraction of the radiostrontium is absorbed by the vegetative tissues of the above-ground part, and a smaller fraction is accumulated in the reproductive organs. Strontium decay did not significantly affect the total harvest or individual plant organs. Stable strontium influences plant harvest positively. The radioisotopes of strontium are extracted by the plants less from black soils than from peat-podzolic soils. The importance of liming as an effective ameliorating factor and a modality in decreased absorption of radiostrontium by the plants was emphasized by the test. (tr-auth)

18304 ERYTHROPOIESIS IN CHIMERIC MICE OF SEVERAL DONOR-HOST COMBINATIONS. Goodman, Joan Wright; Mathews, Mysa C. (Oak Ridge National Lab., Tenn.). Amer. J. Physiol., 210: 563-8(Mar. 1966). (ORNL-P-1236).

Erythropoiesis, measured by 24-hr ^{59}Fe uptake by spleens and erythrocytes, was studied in mice of several genotypes 1 to 2 weeks after irradiation and transplantation of bone marrow cells from isogenic or allogenic mice. When two parental strains, B6 and D_2, and their F_1 hybrid offspring were compared in the nine possible donor-host combinations, erythropoiesis of three groups ($F_1 \rightarrow F_1$, $B6 \rightarrow B6$, and $D_2 \rightarrow F_1$) was significantly greater, and of three others ($B6 \rightarrow D_2$, $B6 \rightarrow F_1$, and $D_2 \rightarrow B6$) significantly less, than that of the remaining groups. B6 and D_2 marrow tested separately in recipients of several other genotypes gave rise to variable erythropoiesis, the extent of which could not be simply correlated with H-2 homozygosity or type of the recipient. Marrow from male and female donors produced erythrocytes equally well in recipients of either sex. The data show that growth of cellular transplants in an irradiated host cannot be predicted accurately from knowledge of H-2 disparities alone. They do not offer any support for an immunological interpretation of poor growth of parental cells in F_1 hybrids. (auth)

18305 SOME CONSEQUENCES OF PULMONARY IRRADIATION. A SECOND LONG TERM REPORT. Teates, David; Cooper, George Jr. (Univ. of Tennessee, Memphis). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 612-19(Mar. 1966).

The long term effects of lung irradiation in patients with thoracic malignant disease were evaluated in 16 persons. Therapeutic doses of radiation brought about adverse changes in the tissues that were evident from 6 to 12 months after irradiation. It is concluded that the beneficial effects of radiation on lung cancer frequently outweigh the adverse effects on lung tissues, resulting in a new improvement in function. (H.G.D.)

18306 EVALUATION OF LYMPH NODE FUNCTION FOLLOWING IRRADIATION OR SURGERY. Dettman, Prentiss M.; King, E. Richard; Zimberg, Yale H. (Medical Coll. of Virginia, Richmond). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 711-18(Mar. 1966).

Following subcutaneous colloidal gold injection behind the posterior foot pad of the hind limb of the dog, practically all of the ^{198}Au that left the site of injection localized in the popliteal lymph node. If the popliteal lymph node was excised, initially the radioactive gold localized in the site, but by 1 month lymphatic continuity was reestablished and the ^{198}Au localized in the abdominal lymph nodes. Following 2,000 R to the popliteal lymph node with orthovoltage x rays at a usual therapeutic rate, colloidal gold continued to localize in the popliteal lymph node site as in the controls. With 6,000 R, 3 of 4 animals, beginning 2 months following irradiation, showed some ^{198}Au reaching the abdominal lymph nodes. With 10,000 R, the distribution of ^{198}Au was the same as that in the controls, probably because of the marked fibrosis that occurred. Irradiation did not entirely eliminate the localization of colloidal gold in the popliteal lymph node site in any case, and it is postulated that with particles as large as cancer cells no alteration would be noted. (auth)

18307 CYTOGENETIC STUDIES IN LEUCOCYTES ON THE GENERAL POPULATION: SUBJECTS OF AGES 65 YEARS AND MORE. Jacobs, Patricia A.; Brunton, Muriel; Court Brown, W. M. (Western General Hospital, Edinburgh). Ann. Human Genet., 27: 353-65(June 1964).

The results are reported of chromosome studies on leukocyte cultures from a randomly chosen group of 189 subjects (87 males and 102 females) of ages 65 or more. Particular attention was paid to the distribution of chromosome counts, the frequency of cells with chromosomes showing a structural abnormality, and the frequency of subjects showing a consistent abnormality or variation in their karyotype. The relation between radiation exposure and structural abnormalities was examined on the basis of the history of exposure to radiation for medical diagnostic and therapeutic purposes for each subject. (TCO)

18308 ON MAXILLARY RADIONECROSES. INDICATIONS AND TECHNIQUES FOR DENTAL EXTRACTIONS. Dargent, Marcel; Bertoin, Pierre (Centre Leon-Bernard, Lyon). Ann. Odonto-Stomatol., 21: 5-12(Jan.-Feb. 1964). (In French).

In irradiation of the buccal cavity it is important to be able to diagnose cases of infection that are of dental origin and to remove the cause rather than to irradiate again under the pretext that it is a matter of a recurrence. Overdosage to an enclosed necrotic center that is also subject to dental infection can lead to a catastrophe. The classic concept that systematic removal of the teeth should be avoided should be modified to one of conservation of those teeth that are outside of the field of irradiation, and which are sound enough to be used by the patient whose general condition will be related very closely to those that can be repaired. General anesthesia should be used for all extractions in an irradiated patient. The dental syringe for

local anesthesia is responsible for most of the mandibular necroses that are observed. Whenever extraction of teeth is required in a patient who has been irradiated in the area of the buccal cavity, the procedure should be entrusted to a specialist who can assume the responsibility and the risk associated with the possibility of infection in the patient. (BBB)

18309 POST-RADIOTHERAPY COMPLICATIONS IN CASES OF CANCER OF THE UTERINE CERVIX. Lalanne, C.-M.; Fajbisowicz, S. (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 8: 697-708(1965). (In French).

Post-therapy complications were studied in 426 cervical cancer patients treated with intracavitary radium therapy, supplemented either with classical radiotherapy, or with telecobalt therapy. Both the minor disorders and the severe lesions that persisted or appeared after the third month following the end of the irradiation were considered as complications. The types and the frequencies of the complications were approximately the same in the two categories: 15.5% for the classical radiotherapy and 20% for telecobalt therapy. Complications occurred in the intestinal tract, the urinary system, the bones, and the skin, but rectal lesions were by far the most frequent form of complication with the irradiation techniques used in these cases. The dose absorbed remains the principal factor in the causation of the complications and it would appear that in this connection, the radium therapy plays a more important part than the external radiotherapy. However, other factors must also be taken into account, such as the area irradiated, the spacing of the doses, errors of technique and associated pathological conditions. (TCO)

18310 THE EFFECT OF X-IRRADIATION ON SPERMATOGENESIS IN DROSOPHILA MELANOGASTER MEIGEN. Abro, Arnold. Arbok Univ. Bergen, Mat.-Nat. Ser., No. 10, 1-21(1964).

The time of puparium formation in Drosophila melanogaster is prolonged when third instar larvae are exposed to x rays. The prolongation increases with increasing doses. Development of testis and spermatogenesis seem to proceed independently of the changes that accompany the metamorphosis. Secondary spermatogonia about to differentiate into spermatocytes are most sensitive to x rays, followed by spermatocytes initiating the meiotic divisions. Low doses sometimes produce bizarre alterations in cell morphology. Supernumerary organelles occur frequently. (auth)

18311 TISSUE REACTIONS AFTER IRRADIATION WITH ^{60}Co. Gruenberg, H. (Univ., Wurzburg, Ger.). Arch. Ohren, Nasen Kehlkopfheilk., 183: 397-401(1964). (In German).

The cytological effects of presurgical treatment with 6000 R of ^{60}Co irradiation given in single doses of 150 R each were studied in laryngeal tissues from several days to 1½ yr after irradiation. Findings are described. (TCO)

18312 X-RAY-INDUCED VARIATION IN MEDICAGO POLYMORPHA VAR. VULGARIS. Brock, R. D.; Andrew, W. D. (CSIRO, Canberra, Australia). Austral. J. Biol. Sci., 18: 1119-28(Dec. 1965).

The response of Medicago polymorpha var. vulgaris to x-ray doses ranging from 20 to 100 kR was typical of other diploid species in the first generation (M-1). The LD_{50} dose was approximately 90 kR. In the M-2 generation the mean flowering time shifted 4.1 days towards lateness, but contrary to expectation the flowering-time variance, after an initial increase at low dose, decreased with increasing dose. In the irradiated populations mean plant diameter was reduced. The reduction was most pronounced in the late selections and in progenies from the higher x-ray doses. There was an environmental correlation ($r_g = -0.27$) between flowering time and plant diameter but virtually no genetic correlation ($r_g = -0.07$). The low flowering-time variance in the M-2 and the lack of response to selection for lateness in the M-3 was associated with increasing temperature during the flowering period and appeared to be due to a change in the biological scale as the temperature increased. Among the irradiated population both early and late families occurred which had diameters comparable with the control families. (TCO)

18313 EXCISION-REPAIR OF DNA DAMAGE IN AN AUXOTROPHIC STRAIN OF ESCHERICHIA COLI. Bridges, Bryn A.; Munson, R. J. (Medical Research Council Radiobiological Research Unit, Harwell, Eng.). Biochem. Biophys. Res. Commun., 22: 268-73(Feb. 3, 1966).

Enzymatic pathways involved in the excision of thymine dimers, nitrogen mustard damage, and the repair of lethal damage due to methylmethanesulfonate and γ radiation in three strains of Escherichia coli were investigated. It is postulated that the production of single strand breaks in the sugar-phosphate backbone of DNA is a reaction common to all pathways. (C.H.)

18314 THE EXCEPTIONALLY SMALL SIZE OF THE SCRAPIE AGENT. Alper, Tikvah (Hammersmith Hospital, London); Haig, D. A.; Clarke, M. C. Biochem. Biophys. Res. Commun., 22: 278-84(Feb. 3, 1966).

Scrapie, a progressive encephalopathy of sheep, is transmissible with cell-free filtrates, and has been classed as a virus. Quantitative studies of the scrapie agent were conducted in mice. The sizes of molecules and macromolecules possessing biological activity were estimated from the manner in which they were inactivated by exposure to electron beams, uv radiation, and x radiation. Results indicate that this agent is very unusual in nature. (C.H.)

18315 ABSENCE OF K REACTIVATION IN A RECOMBINATION-DEFICIENT MUTANT OF E. COLI. Kneser, Hubert (Univ., Cologne). Biochem. Biophys. Res. Commun., 22: 383-7(Feb. 17, 1966).

Experiments showing that a recombination-deficient uv-sensitive mutant of E. coli lacks an essential part of K-reactivation that cannot be replaced by pantoyl lactone or heat treatment are presented. The regulatory K-reactivation however seems to work and dark reactivation is unrestricted. Although the mechanism of K-reactivation remained unknown, the hypotheses can be ruled out that involve filament formation as an essential step in uv killing of K-reactivation-negative strains. K-reactivation: apparently shares a common step with genetic recombination; must be switched on by a special regulatory function or by environmental conditions; and seems to work only on lethal lesions in bacterial DNA. (H.G.D.)

18316 THE CAPACITY OF THE BACTERIAL HOST FOR THE REPRODUCTION OF THE RNA PHAGE f2. II. ITS UV SENSITIVITY IN 5-BU LABELLED HOST AND THE EFFECT OF THE THYMINELESS DEATH. Zavada, Vojtech; Fikotova, Jana; Koutecka, Eva; Neubauer, Zdenek; Raskova, Marie (Charles Univ., Prague). Biochem. Biophys. Res. Commun., 22: 480-3(Mar. 8, 1966).

The effects of uv-sensitization of host DNA on the uv-sensitivity of the capacity of E. coli to reproduce RNA phages was investigated by observing the incorporation of 5-bromouracil (5-BU) into DNA of thymine-requiring bacteria. The capacity was sensitized approximately to the same extent as the colony-forming ability of the cells. A five-fold reduction in the capacity was noted even in the non-irradiated controls. (H.G.D.)

18317 STUDIES ON THE MECHANISM OF RADIATION-INDUCED LEUKEMOGENESIS IN C57BL MICE. Duplan, J. F.; Latarjet, R. (Institut du Radium, Paris). Cancer Res., 26: 395-9(Mar. 1966).

It has been demonstrated that in C57BL mice a subthreshold dose (175 R × 2) of x radiation decreases the latency of lymphosarcomas induced by a leukemogenic virus (leukemogenic extract) and increases the incidence of thymic lymphosarcoma. The percentage of lymphatic tumors remains the same as that produced by only the injection of the extract without irradiation. Futhermore, it has been shown that in C57BL mice irradiated (175 R × 4) and injected with bone marrow cells the leukemogenic extract produced 25% of leukemias in less than 300 days. The different implications of these findings are discussed. (auth)

18318 OVARIAN TUMORIGENESIS IN IRRADIATED PARABIOTIC RATS. Friedell, Gilbert H.; Sommers, Sheldon C.; Chute, Rosanna N.; Warren, Shields (New England Deaconess Hospital, Boston. Francis Delafield Hospital, New York). Cancer Res., 26: 427-34(Mar. 1966). (NYO-901-35).

Supralethal total-body x-irradiation of one parabiont rat with its partner shielded was followed by a growth of unilateral or bilateral ovarian Sertoli-cell tumors in about 20% of exposed animals. Granulosa-theca cell ovarian tumors and gynandroblastomas occurred less often. The tumorigenic process began with irradiation, regardless of age, and Sertoli-cell tumors developed earlier and more frequently than in normal single controls. Parabiosis without irradiation did not result in ovarian tumorigenesis. (auth)

18319 RESULTS OF FRACTIONATION AND PROTRACTION OF TOTAL-BODY RADIATION ON RAT MAMMARY NEOPLASIA. Shellabarger, Claire J.; Bond, Victor P.; Aponte, Gonzalo E.; Cronkite, Eugene P. (Brookhaven National Lab., Upton, N. Y.). Cancer Res., 26: 509-13(Mar. 1966). (BNL-9782).

Female Sprague-Dawley rats showed a high incidence of mammary neoplasia and a large number of mammary neoplasms following exposure to single dose of 500 R of ^{60}Co gamma, total-body radiation. When studied over the entire life-span, these responses were not different when the 500 R were given at either 40 or 160 days of age. Fractionation and protraction of this dose into 4×125 R spread over 2 weeks or 8×62.5 R spread over 4 weeks or 16×31.25 R spread over 8 weeks or 32×15.625 R spread over 16 weeks did not change the incidence of rats with mammary neoplasia or the total number of mammary neoplasms compared to a single dose of 500 R. However, a decreased yield of adenofibroma-fibroadenomas and an increased yield of adenocarcinomas were observed. Mammary adenocarcinomas occur very late in the life of nonexposed females long after a significant incidence of adenofibroma-fibroadenomas has been established and then only in a ratio of approximately 1:5. All radiation exposures tended to shift the appearance of the adenocarcinomas forward in time so that they appeared before the adenofibroma-fibroadenomas with the resulting ratio of approximately 1–4 adenocarcinomas to 1 adenofibroma-fibroadenoma. (auth)

18320 EFFECT OF ULTRAVIOLET RADIATION ON THE INTEGRATION OF GENETIC MARKERS DURING THE TRANSFORMATION OF DIPLOCOCCUS PNEUMONIAE. Louarn, Jean-Michel (CNRS, Gif-sur-Yvette, France). Compt. Rend., Ser. D, 262: 325-8(Jan. 10, 1966). (In French).

Bacteria during transformation have a particular sensitivity to ultraviolet rays. This sensitivity lasts for 90 min after the penetration of DNA. These results can be due to a specific effect on the integration. (tr-auth)

18321 DISSOCIATION, BY IRRADIATION, OF THE ONCOGENIC AND INFECTIOUS FUNCTIONS OF THE ROUS VIRUS OF THE SCHMIDT-RUPPIN STRAIN. Golde, Alice; Latarjet, Raymond (Institut du Radium, Orsay, France). Compt. Rend., Ser. D, 262: 420-3(Jan. 17, 1966). (In French).

A significant proportion of the microtumors (pocks) produced on the chorioallantoid membrane of embryonic chicken eggs by irradiated Rous virus of the Schmidt-Ruppin strain are not virogenic. This shows that the viruses initiating the pocks have maintained their oncogenic power but have lost the capacity to multiply. (tr-auth)

18322 EXPRESSION AND STABILITY OF AN INDUCED MUTATION FOR EAR BRANCHING IN BREAD WHEAT. Swaminathan, M. S.; Chopra, V. L.; Sastry, G. R. K. (Indian Agricultural Research Inst., New Delhi). Curr. Sci. (India), 35: 91-2(Feb. 20, 1966).

A mutant of Triticum aestivum that was isolated in 1957 from seed treated with 10 μc ^{35}S/seed was crossed with other varieties until a dwarf branched wheat variety capable of giving high yields under favorable agronomic conditions was produced. The breeding program is described briefly. (C.H.)

18323 EFFECTS OF THERMAL REACTIONS IN X IRRADIATION OF WHEAT SEEDS. Babayan, R. S. (Lab. of Radiation Therapy, Academy of Sciences, Armenian SSR). Dokl. Akad. Nauk Arm. SSR, 41: No. 1, 51-8(1965). (In Russian).

Wheat seeds were subjected to a 10-minute wet treatment in a water bath or to a 15-minute dry treatment at temperatures of 40, 45, 50, 55, 60, 70, and 80 ± 1°C before and after irradiation with x rays. The steeped seeds were given doses of 500 and 1500 R, and the dry seeds were given doses of 5000 R and 20,000 R. The length of shoot and extent of the root system in the 10-day plant were taken as criteria of growth. The data indicated that the preliminary thermal treatment removed the depressive effect of x-irradiation on plant growth. Thus, the shoot length was 95.3% of the control in unirradiated wheat seeds steeped at 50°C, while the same plant subjected to a dose of 1500 R had a shoot length of 192.1% compared to the control. On subjecting the seeds to a temperature of 55°C without irradiation, the shoot length fell to 1.92 cm compared to 7.20 cm in the control. On irradiating with a dose of 1500 R the shoot length was 2.3 cm compared to 2.79 cm in the control. On irradiating with a dose of 20,000 R, the shoot length was 11.57 cm, and the total length of the root system was 26.4 cm without any preliminary thermal treatment. The respective figures were 15.40 and 40.63 cm with a preliminary thermal treatment at 60°C, and 14.94 and 53.17 cm at 70°C. Thermal treatment after irradiation was found to have a depressing effect on plant growth. Experiments showed that previous thermal treatment decreased the rate of water absorption by wheat seeds steeped in water for 6, 12, and 24 hours, but increased the rate of absorption of ether vapor, to which the seeds were exposed for periods of 2, 4, and 6 days. (TTT)

18324 A STUDY OF GENETIC PROCESSES IN IRRADIATED POPULATIONS. I. NUMERICAL DYNAMICS OF IRRADIATED POPULATIONS. Bileva, D. S. (Inst. of Cytology and Genetics, Academy of Sciences, Siberian SSR). Dokl. Akad. Nauk SSSR, 164: 191-4(Sept. 1, 1965). (In Russian).

The genetic processes occurring in populations exposed to various x-radiation doses were analyzed in order to derive a numerical criterion for estimating the radiation effects and to derive dose relationships. Fifty males and females of an inbred line of D. melanogaster were exposed to 500, 1500, 3000, and 5000 R of x radiation, keeping the temperature constant at 24 to 26°C and using identical feeding conditions for all groups. It was assumed that after a certain number of generations, a numerical equilibrium will be reached. The results showed that during the period from 1 to 17 days, the irradiated populations lag behind the control group; however, within 22 to 45 days, some of the irradiated populations overtook the control group and from 55 to 144 days a numerical steady state was reached. This was followed by a second period of differences and a second equilibrium during the period from the 369th to the 418th day. The initial decrease of the population seems to be due to radiation-induced mutations that reduce the fertility and the viability of the flies; they are rapidly eliminated under intensive breeding conditions. (TTT)

18325 GIANT CELLS PRODUCED BY MITOTIC REVERSION IN PROPHASE, METAPHASE, ANAPHASE, AFTER LOW DOSES OF X-RAYS. Rondanelli, E. G.; Trenta, A.; Magliulo, E.; Vannini, V.; Gerna, G. (Univ., Pavia, Italy. Univ., Bologna). Exp. Cell Res., 41: 1-11(Jan. 1966).

The mechanisms by which mononucleated giant erythropoietic cells are formed in vitro under the action of x-irradiation were studied in triton spleen fragments by phase-contrast microscopy. Though concomitant interkinetic cell growth without division was not investigated, it was demonstrated that erythropoietic cells with higher than normal dimensions may be formed by mitotic block in prophase, metaphase, and anaphase, with subsequent reconstitution of a single nucleus. (auth)

18326 MITOTIC STIMULATION IN NORMAL AND IRRADIATED SUSPENSION CULTURES OF RAT BONE MARROW BY AN ELEVATED SALT CONCENTRATION.

Whitfield, J. F.; Brohee, H.; Youdale, T. (EURATOM, Ispra, Italy). Exp. Cell Res., 41: 49-54(Jan. 1966).

Increasing the sodium concentration of the medium of suspension cultures of rat bone marrow accelerated the entry of normal cells into mitosis. A similar acceleration was obtained in x-irradiated (75 and 100 R) suspensions and the duration of postirradiation mitotic delay was strongly reduced. (auth)

18327 ROLE OF BILE IN DEVELOPMENT OF THE GASTROINTESTINAL SYNDROME IN VERY ACUTE FORMS OF RADIATION SICKNESS. Gorizontov, P. D.; Fedorovskii, L. L.; Lebedeva, G. A. Federation Proc., Transl. Suppl., 25: T107-T110(Jan.-Feb. 1966).

Translated from Arkh. Patol., 27: 19(1965).

In x-irradiated animals bile becomes an inadequate stimulus of the intestine and is of great importance in the pathogenesis of disturbances of the gastrointestinal tract in the very acute form of radiation sickness. Preliminary deflection of the flow of bile from the intestine of irradiated animals reduces the injury to the intestinal epithelium and helps preserve secretion in the goblet cells. Exclusion of bile from the intestine of irradiated animals modifies the reactivity of the intestine to acetylcholine and serotonin. The prevention of radiation diarrhea by deflecting the flow of bile from the intestine is associated with a decrease in the sensitivity of the intestine to acetylcholine and serotonin as well as with the retention of mucus in the goblet cells. (auth)

18328 COMPARATIVE EFFECT OF FAST NEUTRONS, X RAYS AND RADIOACTIVE PHOSPHORUS ON THE FUNCTIONAL CONDITION OF THE HEART. Ryabova, E. Z. (Bogomoletz Inst. of Physiology, Academy of Sciences, Ukrainian SSR). Fiziol. Zh., Akad. Nauk Ukr. RSR, 11: 796-801(1965).

Effects of various forms of ionizing radiation on the functional state of the heart were compared. Cardiac reactions to fast neutrons, x-rays, and radiophosphorus were basically similar though unique in some respects. Neutron effects tended to be latent and more profound, probably because of distribution of absorbed energy. Further, repair processes were impaired more extensively by neutron irradiation than by x-rays or radiophosphorus. (H.G.D.)

18329 STUDY OF THE POST-EMBRYONIC DEVELOPMENT OF THE OVARY IN EPHESTIA KUHNIELLA Z. (LEPIDOPTERA, PYRALIDAE). I. EFFECT OF IONIZING RADIATIONS. Baroughi-Bonab, Hassan. Food Irradiat., 6: A13-A14(July-Dec. 1965).

Female caterpillars were irradiated with doses ranging from 2000 to 15,000 rads. Nymphosis, which took place within 7 days in the controls, was delayed from 9 days in the 2000 rad group to 31 days in the 14,000 rad group. Duration of nymphosis was only slightly affected by irradiation. Radiation effects on ovaries and oogenesis at the various dosages are discussed. Chrysalids were affected less than final-stage caterpillars. (H.G.D.)

18330 EFFECT OF EXTERNAL IRRADIATION ON EXFOLIATED TUMOR CELLS IN CARCINOMA OF THE UTERINE CERVIX. Okagaki, Takashi; Higuchi, Tatsuo; Takeuchi, Shoshichi; Kobayashi, Takashi (Tokyo Univ.). Gann, 56: 559-604(Dec. 1965).

Radiosensitivity of tumor cells was studied quantitatively by vaginal smears of patients with uterine cancer on the assumption that this would reflect host sensitivity as well as sensitivity based on the pattern of cancer cells per se. The percentage of dyskaryotic tumor cells increased in a sigmoid fashion with dose by external irradiation with ^{60}Co. The 50% tumor dyskaryosis dose, which may be identical with the 50% lethal dose of radiation, ranged from 500 to 2,500 R. The relationship between this index and prognosis is as yet to be determined. (auth)

18331 VAGINAL CYTOLOGY AFTER RADIATION THERAPY FOR CERVICAL CARCINOMA. Tweeddale, Duane N.; Greenlaw, Robert J.; Roddick, J. W. Jr.; Leslie, Marjorie D. (Univ. of Kentucky, Lexington). GP, J. Amer. Acad. Gen. Pract., 33: 113-17(Feb. 1966).

Radiation-induced changes in exfoliated vaginal cells were studied in view of their prognostic implications. These changes are illustrated. If more than 70% of superficial cells show these radiation effects, the radiation response is usually considered good. Cancer cells may show marked degenerative changes during therapy and usually disappear by three weeks. Persistence of malignant cells for several weeks after completion of treatment usually carries a poor prognosis. Late cytologic changes after radiation therapy are also described and illustrated. Four illustrative cases of postirradiation changes in vaginal cytology are cited. (TCO)

18332 DISTRIBUTION OF LETHALS INDUCED BY TRITIATED DNA PRECURSORS IN DROSOPHILA MELANOGASTER. Kaplan, W. D.; Gugler, H. D.; Kidd, K. K. (City of Hope Medical Center, Duarte, Calif.). Genetics, 53: 499-511(Mar. 1966).

Sex-linked recessive lethals have been induced in male Drosophila by feeding tritiated deoxycytidine to first instar larvae. The lethals have been localized and their distribution compared to the one previously obtained with tritiated thymidine. The two independently produced distributions differ from each other at the 4% level of significance. Two regional differences have been noted, one of high mutability after tritiated thymidine and one of high mutability after tritiated deoxycytidine. Data combined from the two treatments closely parallel the distribution of lethals induced by x rays and gamma rays, suggesting that the combined distribution reflects the regional content of DNA along the X chromosome. The differences in lethal distributions produced by the two DNA precursors suggest that significant local variations in thymine and cytosine content may exist within chromosomal DNA. (auth)

18333 THE GENETIC STRUCTURE OF NATURAL POPULATIONS OF DROSOPHILA MELANOGASTER. IV. HETEROZYGOUS EFFECTS OF RADIATION-INDUCED MUTATIONS OF VIABILITY IN VARIOUS GENETIC BACKGROUNDS. Mukai, Terumi; Yoshikawa, Isao; Sano, Kikue (National Inst. of Genetics, Mishima, Japan). Genetics, 53: 513-27(Mar. 1966).

Heterozygous effects on viability of induced second chromosome mutations were tested in both homozygous and heterozygous genetic backgrounds (with respect to the second chromosome), in experiments involving approximately 2.8 million flies. The mutations, mainly polygenic, were induced by 500 R x irradiation administered at a dose rate of approximately 100 R/min. Induced mutations are heterozygously slightly beneficial in an otherwise homozygous genetic background which was directly extracted from an equilibrium natural population, while they are, in heterozygous condition, neutral or at least not heterotic in an otherwise homozygous genetic background which was synthesized using 64 unrelated wild-type stocks. When these induced mutations were placed as heterozygotes in either intra- or inter-population crosses, they seemed to be slightly detrimental. The radiation-induced mutation rate of polygenes controlling viability was estimated to be approximately 0.79 per second chromosome per 500 R. The role of overdominance in the maintenance of genetic variation in random mating equilibrium populations is discussed. (auth)

18334 STABILITY OF THE SUPRESSOR ELEMENT IN TWO MUTATOR SYSTEMS AT THE A_1 LOCUS IN MAIZE. Neuffer, M. G. (Univ. of Missouri, Columbia). Genetics, 53: 541-9(Mar. 1966).

Cultures carrying both Dt- and Spm-responding mutable A_1 alleles, but lacking the mutators, were treated with ultraviolet light, x rays, and ethyl methanesulfonate in an effort to induce reversion of the mutable alleles to A. The results were negative, but several cases of induction of Dt and Spm were found. These appear to result from chromosome breakage at a limited number of sites. Similar cultures were examined for spontaneous reversion to A, which would indicate copying errors in the suppressor element. No cases were found in 252×10^6 chances. The remarkable stability observed in this material poses some questions

about the suppressor element hypothesis. The induction of new Dt and Spm activity reinforces the conclusion that chromosome breakage is the mechanism for their origin and the greater efficiency of ultraviolet in this induction suggests that the sites of origin of Dt and Spm are physically small and probably limited in number. (auth)

18335 VARIATIONS IN RADIOSENSITIVITY DURING MEIOSIS OF POLLEN MOTHER CELLS IN MAIZE. Eriksson, Goesta; Tavrin, Edvard (Royal Coll. of Forestry, Stockholm. Univ. of Stockholm). Hereditas, 54: 156-69(1965).

The induction of waxy pollen grains was studied after acute γ-irradiation with 100 rad and 200 rad. In both experiments the induced and spontaneous mutation rates were estimated in pollen grains fixed at different numbers of days after treatment. The ratio between the induced maximum and minimum mutation rates of the different fixing days amounted to about 30. It was suggested that the differences were caused by variations in radiosensitivity of the irradiated stages. Treatment during pachytene and/or diplotene seemed to induce the highest number of waxy pollen grains. (auth)

18336 X-RAY INDUCED MINUTES IN DROSOPHILA MELANOGASTER SPERM EJACULATED IN CONSECUTIVE MATINGS. Kvelland, Ingerid; Stroemnaes, Oeistein (Univ. of Oslo). Hereditas, 54: 170-6(1965).

X-ray induction of minutes was studied in individual sperm ejaculates of males that were either 0 to 2 hours, 24 hours, or 72 hours old at the time of irradiation. All males went through three 12-hr mating periods, the second of which was without females. For all groups of males the frequency of minutes was higher in the first than in the second mating period. The difference in frequency of minutes between age groups of males was significant when measured in the first mating period but insignificant in the second mating period. Data supported previous reports that a change in mutation frequency does occur at an earlier time after irradiation for sperm released by young males. (TCO)

18337 RESTORATION OF REGENERATIVE CAPACITY SUPPRESSED BY X IRRADIATION. Polezhaev, L. V. (Inst. of Animal Morphology, Moscow). Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 37-58(Jan.-Feb. 1966). (In Russian).

Suppression of regenerative capacity by x-irradiation averaged 93% in Axolotl limbs. Wound healing was often followed by radioinduced ulceration on the amputated stumps. Restoration of the regenerative capacity was affected in 30 to 35% of the animals by injecting highly polymeric RNA or homogenates of mammalian muscle, liver, or other tissues. Recovery was even higher (70 to 100%) after repeated limb amputations. Factors affecting the restoration of regenerative ability were: the time interval between irradiation and amputation; and severity of amputation injury; and injection of preparations. (H.G.D.)

18338 THE STATE OF COMPENSATORY MECHANISMS OF THE NERVOUS SYSTEM EXPOSED TO LARGE DOSE OF RADIATION. Galichii, V. A. Izv. Akad. Nauk SSSR, Ser. Biol., No. 1, 134-40(Jan.-Feb. 1966). (In Russian).

Rabbits labyrinthectomized unilaterally prior to 1600 R doses of whole-body γ-irradiation showed impairment of previously formed compensatory mechanisms. Nystagmic reactions indicated no loss of equilibrium during rotation 3 to 5 days after surgery, probably because of the high plasticity of the nervous system and a progressive depression of its functions. Gamma irradiation of intact animals resulted in nystagmic reactions that suggested a significant stability of reflex mechanisms in the brain stem. (H.G.D.)

18339 THRESHOLD FOR CONDITIONED SUPPRESSION USING X-RAYS AS THE PRE-AVERSIVE STIMULUS. Morris, Dale Duane (Argonne National Lab., Ill.). J. Exp. Anal. Behav., 9: 29-34(Jan. 1966).

The conditioned suppression technique was used to demonstrate that a brief burst of x rays serve as a pre-aversive stimulus for rats. Four male, 12-week-old Sprague-Dawley rats were used to determine the threshold for behavioral response to x irradiation. They were maintained at 80% body weight and initially trained to stable performance on a 1-min VI reinforcement schedule with 16% sucrose solution as the reinforcement. After a stable baseline was obtained the animals were placed in the instrumental conditioning box beneath the x-ray machine for a half-hour session each day. While subjects were actively pressing the lever for reinforcement, 15-sec x-ray exposures of 0.5 R/sec were administered, followed immediately by electric shock. After all animals had exhibited conditioned suppression, the dose-rate was decreased in subsequent sessions in an effort to establish threshold. The results indicated that x rays at a dose rate as low as 0.004 R/sec can be an effective pre-aversive stimulus for the rat. There was a definite relation between the dose rate and the magnitude of the suppression ratio. As dose rate decreased, the suppression ratio increased. This is a function of dose-rate intensity and not stimulus generalization; the sessions at each dose rate were training sessions and not simply testing sessions. During the experiment, the kilovoltage of the x-ray machine was reduced to obtain the lower dose rates. Since this changes the x-ray spectrum, the 0.04 R/sec dose rate run at 200 kv was compared with the 0.04 R/sec dose rate run at 80 kv. There was no difference in the behavioral suppression; thus, dose rate, and not the nature of the x-ray spectrum employed, determined the magnitude of conditioned suppression. The min dose rate for obtaining a behavioral response to x rays was lower than previously reported for mammals. (BBB)

18340 RADIATION RESISTANCE OF SPORES OF CLOSTRIDIUM SPECIES IN AQUEOUS SUSPENSION. Roberts, T. A.; Ingram, M. (Low Temperature Research Station, Cambridge, Eng.). J. Food Sci., 30: 879-85(Sept.-Oct. 1965).

The resistance to radiation of a wide selection of Clostridium spores was examined under standard conditions, to allow a reliable estimate of the resistance of these organisms under a variety of conditions, and make it possible to estimate the likelihood that they might survive particular irradiation treatments. One-ml samples of aqueous spore suspensions in ampoules sealed under air were γ irradiated at ambient temperature (18–23°C) in a 4000-C ^{60}Co at 1.05 Mrad/hr. Suspensions contained 3.58×10^7 to 7.33×10^8 spores per ml. The data presented enable survivor curves to be constructed for unheated spores of the following clostridia: C. aerofoetidum; C. bifermentans; C. botulinum types A, B, C, D, E, and F; C. butyricum; C. caloritolerans; C. chauvoei; C. histolyticum; C. fallax; C. oedematiens types A, B, and C; C. septicum; C. sordellii; C. sphenoides; C. sporogenes; C. subterminale; C. tertium; C. tetanomorphum; C. welchii types A, B, C, E, and F. After irradiation at 18 to 23°C, survival curves comprised a shoulder extending to about 0.25 to 0.35 Mrad, followed by an exponential kill over 6 to 8 log cycles with a decimal reduction value from 0.08 to 0.25 Mrad. The data, having a bearing on several aspects of radiation processing of food, are discussed in terms of: (1) desirable degree of inactivation; (2) radiation resistance of clostridia other than C. botulinum; (3) the importance of the shoulder on survivor curves; (4) indicator organisms; and (5) proteolysis and toxin production. It is concluded that no common Clostridium will be found which is more resistant to radiation than C. botulinum: the existence of heat-resistant indicators. Since the difference in radiation resistance is relatively small, and the size of the shoulder varies from one species to another (and from one strain to another), it is questionable whether any of these organisms is likely to be a suitable indicator organism in radiation processing. (BBB)

18341 EFFECTS OF X RADIATION ON THE METABOLISM OF NUCLEIC ACIDS IN RAT SPLEEN CELLS DURING THE COURSE OF PRIMARY IMMUNE RESPONSE. Mori, Kazuhiro J. (Kyoto Univ.). J. Radiat. Res. (Jap.), 6: 1-10(Mar. 1965).

Male Wistar rats were immunized with BGG and the

effects of x radiation on the nucleic acids in their spleen were studied during the period of primary immune response. Amount of DNA increased on the 9th day of immune response reaching twice as much as the unimmunized rats. DNA was markedly reduced by the irradiation with 500 r of x radiation. RNA increased also on the 10th day and it was reduced considerably by x ray. Particular changes caused by the administration of antigen were found in the chromatographic pattern of RNA by DEAE-cellulose column, and x radiation diminished such changes ascribed to an immune response. (auth)

18342 SENSITIVITY OF ARTEMIA EGGS TO γ IRRADIATION. V. BIOLOGICAL AFTER-EFFECT OF IRRADIATION IN RELATION TO WATER CONTENT AND TEMPERATURE. Iwasaki, Tamiko (National Inst. of Radiological Sciences, Chiba, Jap.). J. Radiat. Res. (Jap.), 6: 11-16(Mar. 1965).

Artemia dry eggs irradiated with γ rays showed the biological after-effect; the hatchability of the eggs decreased with increased storage time. Such effect can be modified by various treatments applied after the irradiation. The effects of water content and temperature upon storage after irradiation on Artemia dry eggs were examined. Artemia dry eggs were γ irradiated and then stored for one, three, and seven days in various conditions. The hatchability was examined for each treatment to assess the biological damage. Radiation damage after irradiation was considerably increased by the water content in highly dried eggs (water content, 7.4%). On the other hand, in the moistened eggs (9.6%, 18.5% and 35.1%) the damage was not so pronounced as compared to the highly dried eggs, and no appreciable difference in the after-effect was found among them. The after-effect was temperature dependent; the dry eggs kept in dry ice did not reveal the decrease of hatchability. The possible mechanism of the biological after-effect on Artemia eggs was discussed. (auth)

18343 EFFECTS OF WHOLE-BODY X IRRADIATION ON OXIDIZED AND REDUCED TRIPHOSPHOPYRIDINE NUCLEOTIDE CONCENTRATION IN RAT ORGANS. Ichii, Shogo; Kobayashi, Shigeru (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res. (Jap.), 6: 17-22 (Mar. 1965).

The effects of half lethal dose (600 r) of whole-body x-irradiation on the concentration of oxidized (TPN) and reduced triphosphopyridine nucleotide (TPNH) in liver, spleen, kidney, adrenal and testis of rats were studied. There was no significant change observed in both coenzymes of liver, while the TPNH concentration of spleen decreased markedly following the irradiation. In kidney and testis of the irradiated animals, the gradual increase of the TPNH concentration was observed. The concentration of both TPNH and TPN in adrenal was elevated on 1st and 3rd day after irradiation and returned to normal levels by the 5th day. The physiological implications of these findings were discussed. (auth)

18344 OBSERVATIONS ON IRRADIATION-INDUCED DAMAGE IN BACTERIAL SPORES. Farkas, Jozsef; Kiss, Istvan (Central Food Research Inst., Budapest). Kozp. Elelmiszeripari Kutatointez. Kozlem., No. 1, 13-19 (1964). (In Hungarian).

Suspensions of Bacillus cereus spores in both the resting and the germinating stage as well as of the vegetative cells were x irradiated. The resistance shown by the spores in the resting stage, as shown by viable cell count determinations in the suspensions, was about seven-fold that of the vegetative cells, while the radiation sensitivity of the germinated spores practically equalled that of the vegetative cells. The germination of resting spores was not inhibited even at a 1-Mrad dose level. The lethal effect of irradiation was manifested in the inhibition of outgrowth and vegetative reproduction of the germinated spores. The first phase of germination seemed to be stimulated by irradiation, for the number of germinated (dark) spores significantly increased, i.e., the initially small number trebled after irradiation at a 1-Mrad level in a nutrient free medium. The dehydrogenase activity of irradiated suspensions, as measured by triphenyltetrazolium chloride, was also investigated. It appeared that the radiation resistance of the cell components playing a part in propagation is far exceeded by that of the cell dehydrogenases. Since radiation doses of the order of 2 to 2.5 Mrad, which are considered lethal, are not sufficient for complete inhibition of the enzyme activity, it seems advisable to combine them with an enzyme-inactivating heat treatment. The death rate of the surviving spores was increased about one and a half times (in a medium of pH = 6.0 and at 90°C) by irradiation at the 600-krad level. (BBB)

18345 THE EFFECT OF GAMMA IRRADIATION ON THE VARO RACE OF BOMBYX MORI L. II. IRRADIATION OF EGGS IN THE EARLY AND LATE EMBRYONIC STAGES. Gubicza, Andras; Molnar, Istvan (Research Inst. of the Textile Industry, Budapest). Magyar Tud. Akad. Tihanyi Biol. Kutatointez. Evkonyve, 31: 3-13(1964).

Results are summarized from a study of the effects of γ radiation on the eggs of the silkworm, Bombyx mori, exposed during various developmental stages, and on the morphology of larvae and on the health and fecundity of adults moths hatched from irradiated eggs. (C.H.)

18346 PULMONARY REACTION IN ^{137}Cs GAMMA IRRADIATION OF PATIENTS WITH CANCER OF THE ESOPHAGUS. Tret'yakova, T. A.; Guseva, I. L. (Central Medical Inst. for Graduate Work, USSR). Med. Radiol., 10: No. 11, 72-6(Nov. 1965). (In Russian).

Acute lung reactions were observed in 30.6% of 75 patients treated with ^{137}Cs γ rays for esophageal cancer. Radioinduced lung reactions were stable in nature and frequently terminated in pneumosclerosis and heart disorders. The role of absorbed focal dose in frequency of lung injuries following radiotherapy was emphasized. (H.G.D.)

18347 THE UTILIZATION OF LEAKY AD-3 MUTANTS NEUROSPORA CRASSA IN HETEROKARYON TESTS FOR ALLELIC COMPLEMENTATION. de Serres, F. J. (Oak Ridge National Lab., Tenn.). Mutat Res., 3: 3-12(Feb. 1966). (ORNL-P-1160).

Heterokaryon tests were made on pairwise combinations of leaky ad-3 mutants of Neurospora crassa to test for allelic complementation at the ad-3A and ad-3B loci. Since leaky mutants produce a protein, such heterokaryon tests should provide a critical test for the occurrence of allelic complementation at these two loci. A comparison was also made with similar tests on nonleaky ad-3A or ad-3B mutants. No evidence for allelic complementation was found in any pairwise combination of 28 leaky and 38 nonleaky ad-3A mutants, providing additional evidence that ad-3A is a one-complon locus. (TCO)

18348 TEMPERATURE-SENSITIVE MUTATION IN PARAMECIUM AURELIA. I. INDUCTION AND INHERITANCE. Igarashi, Satomi (Oak Ridge National Lab., Tenn.). Mutat. Res., 3: 13-24(Feb. 1966). (ORNL-P-1355).

A new class of mutation was induced by x radiation in Paramecium aurelia. These mutant segregants were called temperature-sensitive mutants (ts mutants) since they can grow normally at 27° but are inviable at 36°. The maximum yield of ts mutant segregants after 2 kR of x radiation was about 14% of the segregants viable at 27°. Crosses between different ts mutant stocks revealed that these ts loci are widely spread over the genome of Paramecium. Certain subsidiary problems arising in the course of the work and the genetic applications of the ts mutations to genetic analysis of paramecia were discussed. (auth)

18349 TEMPERATURE-SENSITIVE MUTATION IN PARAMECIUM AURELIA. II. MODIFICATION OF THE MUTATION FREQUENCY BY PRE- AND POSTIRRADIATION CONDITIONS. Igarashi, Satomi (Oak Ridge National Lab., Tenn.). Mutat. Res., 3: 25-33(Feb. 1966). (ORNL-P-1408).

The effect of various pre- and postirradiation conditions

on the yield of temperature-sensitive (ts) and ordinary lethal mutations is described, and compared with the results of earlier work in Paramecium aurelia. Certain conditions, such as stage in the division or growth cycle, streptomycin treatment, and postirradiation starvation, affect the yield of ts and ordinary lethals in the same way, and these are the conditions that might be expected to influence mutation fixation through repair of premutational damage. With clonal age, and under similar conditions, there appears to be a conversion of temperature-sensitive mutations into lethal mutations, a conversion which might be expected from the different physiological changes occurring in aging paramecia. (auth)

18350 EVIDENCE FOR A DOSE-SQUARED TERM IN THE DOSE-RESPONSE CURVE FOR REAL CHROMATID DISCONTINUITIES INDUCED BY X-RAYS, AND SOME THEORETICAL CONSEQUENCES THEREOF. **Revell, S. H. (Royal Cancer Hospital, London). Mutat. Res., 3: 34-53(Feb. 1966).**

New estimates are given of dose-response parameters for chromatid aberrations induced in root-meristem cells of the broad bean, Vicia faba, by x ray doses in the range 20 to 100 R. In terms of the power-law model, yield per cell induced by dose $D = kD^n$, values of the dose exponent n were derived for the different aberrations. Real chromatid discontinuities are relatively rare after all doses, being only about 2.5 times more frequent than sister non-unions of isochromatid discontinuities. It is suggested that the general belief that chromatid breakage is linearly related to x-ray dose has been based on scores that were large over-estimates, due to the inclusion of gaps. (TCO)

18351 RELATION BETWEEN THE X-RAY DOSE AND THE RATE OF DOMINANT LETHALS INDUCED BY IRRADIATION OF MOUSE SPERMATOZOA. **Leonard, A. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). Mutat. Res., 3: 73-8(Feb. 1966).**

Male mice received testicular irradiation with increasing x-ray doses from 100 to 6000 R. After irradiation, each male was mated with 3 virgin females. Dissection of the females showed that the percentage of pregnant females decreases with the dose of x-irradiation received by the male. Results show that the relationship between dominant lethal mutation rate and x-ray dose is linear. The ratio of deaths before implantation/deaths after implantation increases only for high doses. (auth)

18352 INDUCTION OF CHROMOSOME STRUCTURAL DAMAGE IN EHRLICH ASCITES TUMOUR CELLS. **Hawes, Christine; Howard, Alma; Gray, L. J. (Mount Vernon Hospital, Northwood, Eng.). Mutat. Res., 3: 79-89(Feb. 1966).**

The proportion of Ehrlich ascites cells showing abnormal telophase figures was measured at the time of their maximum rate of appearance, after reinoculation into new hosts of cells irradiated in vitro. The oxygen enhancement ratio for sensitivity to 200 kv x rays was $m = 2.7 \pm 0.1$. It was not significantly different for low and high dose portions of the dose-response curve. The concentration of oxygen dissolved in the medium at the time of irradiation that resulted in one half of the oxygen-dependent sensitivity was $Ko_2 = 3.5 \pm 0.5$ $\mu M/l$. The value of Ko_2 was not significantly different for cells irradiated at 3°, 18°, and 34°, and it was concluded that the oxygen enhancement ratio at any oxygen concentration is independent of temperature in this range. The effectiveness of oxygen was not altered by the identity of the diluting gas, whether helium, nitrogen or argon. (auth)

18353 STUDIES ON EXPERIMENTAL RADIATION INJURY IN MICE BY INTERNAL ^{90}Sr. II. RELATIONSHIP BETWEEN BLOOD CELL COUNTS AND LETHAL EFFECT OF INJECTION WITH ^{90}Sr. **Hayashi, Mitsuaki; Miyao, Noboru (National Inst. of Animal Health, Tokyo). Nat. Inst. Anim. Health Quart., 5: 231-7(Winter 1965).**

Mice were injected intraperitoneally with doses of ^{90}Sr ranging from 0.01 to 15.0 $\mu C/g$. On the 30th day after the injection, they were examined for: changes in the leukocyte and erythrocyte counts; the lethal effect of ^{90}Sr; and the deposition dose of ^{90}Sr and cumulative internal radiation dose in the femur. The leukocyte count did not change in animals injected with a dose below 0.2 $\mu C/g$ (8.5 $m\mu C/mg \cdot Ca$ as deposition dose, or 117 rad as cumulative radiation dose, in the femur). It decreased definitely, however, in animals injected with a dose over 0.4 $\mu C/g$ (14.9 $m\mu C/mg \cdot Ca$, or 207 rad) and dropped markedly in those with a dose over 2.0 $\mu C/g$ (93.6 $m\mu C/mg \cdot Ca$, or 1,396 rad). No changes were observed in the erythrocyte count in any group of mice. The $LD_{50/30}$ of ^{90}Sr was 4.0 $\mu C/g$ as the injection dose, 214 $m\mu C/mg \cdot Ca$ as the deposition dose, and 2,560 rad as the cumulative internal radiation dose in the femur. Those doses of ^{90}Sr exceeding 5.0 $\mu C/g$ had a 100 per cent lethal effect. The ratio of dry-matter weight to wet weight and the specific gravity of the femur rose with the increase of the injection dose of ^{90}Sr. (auth)

18354 RADIATION-INDUCED MITOTIC DELAY IN SPERMATOGENESIS OF DROSOPHILA MELANOGASTER. **Traut, H. (Univ., Muenster, Ger.). Nature, 209: 92-3 (Jan. 1, 1966).**

Observations by Welshons and Russel (Proc. U.S. Nat. Acad. Sci., 43: 608 (1957)) to support the postulate that radioinduced mitotic delay occurs in the testis of Drosophila melanogaster are discussed. (M.C.G.)

18355 KINETICS OF TWO-BREAK CHROMOSOME EXCHANGES AND THE SPATIAL ARRANGEMENT OF CHROMOSOME STRANDS IN INTERPHASE NUCLEUS. **Kumar, Sushil; Natarajan, A. T. (Indian Agricultural Research Inst., New Delhi). Nature, 209: 796-7(Feb. 19, 1966).**

Dry barley seeds (Hordeum vulgare) were irradiated with ^{60}Co γ rays (25 to 50 kR doses) and fast neutrons (200 to 800 R doses). The yield of dicentrics and rings was evaluated at colchicine-blocked first mitosis from feulgen-stained squash preparations. Distributions of two-break aberrations were observed to be Poisson at low doses and non-Poisson at high doses. An interpretation of over-all response was suggested and a model put forth concerning the spatial organization of chromosomal strands in the interphase nucleus. Data also indicate that a general formulation on the kinetics of two-break chromosome aberrations should take into consideration the size of the chromosome complement, nuclear volume, and nature of karyotypic symmetry. (H.G.D.)

18356 INDUCTION OF CHROMOSOME INJURIES IN MOUSE BONE MARROW UNDER THE DISTANT EFFECT OF IONIZING RADIATION. **Barakina, N. F.; Yanushevskaya, M. I. (Inst. of Animal Morphology, Moscow). Nature, 209: 823-4(Feb. 19, 1966).**

The distant effect of radiation on the appearance and character of chromosome injuries was studied in bone marrow cells of x-irradiated mice. The animals were divided into three groups: some were given 700 R doses to one hind lamb, the body being shielded; and others were given 700 or 3000 R doses to surgically exteriorized intestine. Then only one hind limb was exposed to radiation, a distinct increase in the number of cells with chromosome injuries was found in the shielded regions of the bone marrow, the majority, however, of which had bridges. The percentage of cells in nonirradiated bone marrow with chromosome injuries was approximately the same after 700 R doses to either the hind limb or the exteriorized intestine. The data presented indicate that chromosome injuries in shielded regions are induced by humoral influences. (H.G.D.)

18357 FUNDAMENTAL STUDIES OF SIEVE THERAPY. PART 2. **Nitta, Teruo (Kyoto Univ.). Nippon Acta Radiol., 25: 1-13(Apr. 1965). (In Japanese).**

The effects of sieve x-irradiation on rabbit ears were studied histologically. Severity of erythema and dermatitis varied when the sieve openings were displaced prior to delivery of each radiation fraction; as did histological findings in the epidermis and hair follicles. Blood vessels showed no significant difference after 20,000 R, but significant differences in the histological picture were observed after 40,000 and 100,000 R. Implications for sieve therapy on human skin are discussed. (H.G.D.)

18358 ACUTE RADIATION OEDEMA OF PERITHYROID TISSUES—A SERIOUS COMPLICATION OF THE TREATMENT OF THYROID DISORDERS WITH HIGH DOSES OF RADIOIODINE. Hoeschl, R.; Nemec, J.; Silink, K.; Kubal, J. (Research Inst. of Endocrinology, Prague). Nucl.-Med., 5: 68-75(1965).

Seventeen cases of soft tissue edema developing early after radioiodine treatment of thyroid cancer are described. The syndrome is believed to be a life-threatening clinical entity complicating the early course of radioiodine treatment of thyroid cancer, and differing from radiation thyroiditis. Two similar cases were found in the literature. The incidence of perithyroid edema in patients was 13.2%. Perithyroid edema occurred usually after large single doses but was not predictable. The possible preventive measures and therapeutic effect of corticoids as life-saving treatment are pointed out. (TCO)

18359 ATTEMPTS TO ISOLATE VIRUS FROM X-RAY INDUCED LEUKEMIAS IN THE MOUSE. Hodes, M. E.; Palmer, C. G.; Hubbard, J. D. (Indiana Univ., Indianapolis). Oncologia, 19: 294-310(1965).

Lymphosarcomas induced in C57BL/10 and C3H/eb mice by x-irradiation as well as a transplantable, x-irradiation induced tumor originated by Snell, Lymphosarcoma S913, were carried by serial transplantation. Cell free extracts and nucleic acids were prepared from these tumors and used to inoculate newborn mice of the same or different strains. Preparations from the S913 lymphosarcoma caused an increase in lymphomas in C57BL/10 and C57BL/6 mice, but this was not significant at the 5% level when compared to alternate litter controls. A significant increase in lung tumors (adenocarcinomas and adenomas) was seen in Swiss mice. Filtrates and DNA prepared from lymphosarcomas induced by x-irradiation in C57BL/10 (but not in C3H/eb) caused a significant increase in lymphomas (reticulum cell sarcomas) in C57BL/10 mice. Attempts to increase the potency of the S913 preparations by blind intracerebral or tissue culture passage were not successful. Preparations from two of the induced tumors caused a significant increase in lymphomas on inoculation into Swiss mice, but no passage material was obtained. The results are not considered proof of the viral etiology of x-ray induced lymphosarcomas. (auth)

18360 PHOTOREACTIVATION OF CLOVER YELLOW MOSAIC VIRUS. Chessin, Meyer (Univ. of Minnesota, Minneapolis). Photochem. Photobiol., 4: 709-11(Sept. 1965).

Of the plant viruses so far tested, only two which appear to be rigid rods in the electron microscope, tobacco mosaic and tobacco rattle, do not exhibit photoreactivation, although the infective nucleic acids of both are photoreactivable. All of the others, consisting of elongated flexuous particles (potato virus X, cabbage black ringspot virus) or those of spherical or polyhedral shape (tomato bushy stunt, tobacco necrosis, cucumber mosaic, and tobacco ringspot viruses) show varying degrees of photoreactivation. Tests were conducted on the photoreactivability of the clover yellow mosaic virus (CYMV), which has flexuous rods and would therefore be expected to show photoreactivation on the basis of the previous results with those of similar morphology. Two phenomena were evident from the results. The first was a marked inhibition of infection when leaves were illuminated for 24 hr after inoculation as compared to darkened controls. The second observed phenomenon was the photoreactivation of uv-irradiated virus. The photoreactivability of CYMV, an elongated, flexuous virus, is in agreement with results previously obtained with plant viruses of similar morphology. (BBB)

18361 THE RELATIONSHIP BETWEEN CAROTENOID PIGMENTS AND RESISTANCE TO RADIATION IN NON-PHOTOSYNTHETIC BACTERIA. Mathews, Micheline M. (Harvard Univ., Cambridge, Mass.); Krinsky, Norman I. Photochem. Photobiol., 4: 813-17(Sept. 1965).

When a radiation-resistant Micrococcus and a colorless mutant were subjected to γ radiation, they were found to have identical killing curves. Similar results were obtained with uv light. However, when exposed to visible light in the presence of the photosensitizer, toluidine blue, the pigmented wild type was unaffected whereas the colorless mutant was killed. Sarcina lutea and a colorless mutant were killed at similar rates following exposure to x rays and uv light, whereas previous studies have demonstrated that the pigmented wild type is protected against lethal photosensitizations by visible light. It is concluded that the effect of carotenoid pigments in radiation damage is limited to protecting cells against the lethal effects of visible light and is without effect at shorter wavelengths. (BBB)

18362 ANTIRADIATION PROTECTION IN CONNECTION WITH THE PROBLEM OF THE RBE OF RADIATIONS WITH LOW SPECIFIC IONIZATIONS. Yarmonenko, S. P.; Konoplyannikov, A. G. Probl. Kosm. Biol., 4: 139-64 (1965). (In Russian).

Results of 74 Soviet and 50 Western studies on the relationship between LET and RBE of ^{60}Co γ rays, protons, and x rays are tabulated. Data from Soviet research on the effectiveness of various radioprotectors are also presented. (H.G.D.)

18363 RESULTS OF MICROBIOLOGICAL AND CYTOLOGICAL INVESTIGATIONS CONDUCTED DURING THE FLIGHTS OF VOSTOK TYPE VEHICLES. Zhukov-Verezhnikov, N. N.; Rybakov, N. I.; Kozlov, V. A.; Saksonov, P. P.; Dobrov, N. N.; Antipov, V. V.; Podoplelov, I. I.; Parfenov, G. P. Probl. Kosm. Biol., 4: 261-9(1965). (In Russian).

When normal and cancerous human cells were exposed in the Vostok series, it was found that these experimental samples did not differ essentially from control samples kept on earth. However, some tendency to intensification of phage production was observed in cultures of E. coli in this series (an increase by a factor of 1.2 on Vostok-2, 4.6 on Vostok-3, and 1.96 on Vostok-4). Data from repeated exposure of the same biological object indicate accumulation of the spaceflight effect, although the character of this accumulation is not clear. In a comparison of the results of Vostoks 3-6, it was not possible to establish a linear dependence of biological effect on time of exposure in space. However, factors causing a genetic effect (an increase in the phage-producing activity of a lysogenic culture) definitely operated during these flights. The following derived values of induced phage production were calculated: ~3 for Vostoks 3 and 5 (corresponding to the inducing effect of 3.2 rad of gamma rays), and 1.8 for Vostoks 4 and 6 (corresponding to 0.8 rad of gamma rays). Since the doses quoted are higher than those encountered in spaceflight, the observed genetic effect must therefore be partially due to other factors (such as weightlessness, acceleration, vibration, etc.). To study the operation of one of these factors, E. coli K-12 was subjected to vibrations of 18, 35, 75, 100, and 700 cps for 15 to 30 min. and, in another series of experiments, to vibration in combination with ^{60}Co γ rays. The experimental results show that vibration alone does not induce phage production but does increase the sensitivity of lysogenic bacteria to the subsequent influence of γ irradiation. It is suggested that vibration helps sensitize cells of a lysogenic culture to the influence of cosmic radiation, although it is also possible that the cause of genetic changes is weightlessness in combination with radiation. (ATD)

18364 MORPHOLOGICAL CHANGES IN THE HEMATOPOIETIC ORGANS OF MICE AFTER IRRADIATION WITH HIGH-ENERGY PROTONS. Gaidamakin, N. A.; Petrukhin, V. G.; Shashkov, V. S.; Antipov, V. V.; Saksonov, P. P. Probl. Kosm. Biol., 4: 430-6(1965). (In Russian).

Pathological changes in the morphology of the hematopoietic organs of male mice were studied after proton and gamma-irradiation. Animals were subjected to proton irradiation (830 rad) or ^{60}Co γ rays (650 R). The mice were killed 3, 7, 15, 30, or 60 days after irradiation, and cells of the spleen, thymus gland, and bone marrow of the femur were examined microscopically. Observation of animals and comparative study of hematopoietic organs

showed that changes due to irradiation with protons and γ rays are similar. Changes were less severe during proton-irradiation and recovery proceeded more slowly in the γ irradiated animals. (TCO)

18365 ULTRAVIOLET IRRADIATION OF PLANTS AS A PROBLEM OF SPACE PHYTOPHYSIOLOGY. Shakhov, A. A.; Shishchenko, S. V.; Stanko, S. A.; Shaidurov, V. S.; Golubkova, B. M. Probl. Kosm. Biol., 4: 474-86(1965). (In Russian).

Experiments on effects of ultraviolet radiation on photosynthesis are reviewed, and applications in space biology are emphasized. In the first group of experiments described, plants grown under conditions of normal polar illumination were irradiated additionally with ultraviolet and infrared light, in most cases simultaneously. Electron microscopy of chloroplasts separated from these plants showed that shortwave uv-irradiation changes the submicroscopic structure of chloroplasts. However, due to the photoreactivation capacity of plants, some recovery from injuries occurs. In a second series of experiments conducted at an altitude of 3200 m, radishes were subjected to additional artificial uv-irradiation daily for 10 minutes. Changes in chloroplast structure and pigment content were observed. Preliminary studies showed that in chloroplasts of cabbage, beet, bean, turnip, and pea leaves, pigment content increased during short-term uv-irradiation, and decreased when the exposure was longer. Studies conducted at high altitude laboratories established that when natural ultraviolet irradiance is high, absorption by leaves of radiant energy from ultraviolet and infrared rays increases. These data indicate that plants growing in extreme conditions (such as space flight) use radiant energy in a wider spectral band for their vital activity. (TCO)

18366 THE DETERMINATION OF THE LD_{50} WITH ^{60}Co OF CERTAIN SPECIES OF MILLIPEDS. Albert, Nolan James (Louisiana State Univ., Baton Rouge). Proc. Louisiana Acad. Sci., 28: 121-2(Dec. 1965).

Lethal dosage determinations and behavioral patterns are reported for five species of millipeds exposed to ^{60}Co γ rays. Lethal doses for the five species were: Pseudopolydesmus serratus, 16,000 R; Narceus americanus, 54,000 R; Oxidus gracilis, 180,000 R; Pachydesmus c. crassicutis, 140,000 R; and Abacion texense, 120,000 R. Calcium content was determined in the exoskeletons of three species, and the species with the largest amount of exoskeletal calcium was the most radioresistant. (H.G.D.)

18367 THE EFFECTS OF CHLORPROMAZINE AND IONIZING IRRADIATION ON CONSUMATORY BEHAVIOR IN RATS. Rye, Merrill M.; Elder, S. Thomas (Louisiana State Univ., New Orleans). Proc. Louisiana Acad. Sci., 28: 123-6(Dec. 1965).

Nineteen rats were divided into four groups in an experiment designed to factorically compare the effects of chlorpromazine (CPZ) and 600 R whole-body x-irradiation on the feeding behavior of rats maintained on a restricted feeding schedule. The results suggest that the radioprotective properties of CPZ (0.3 mgm/kg, i.p.) are doubtful, and indicate that x-irradiation produces a reduction in food intake approximately 3 days after exposure, followed by rapid recovery. (auth)

18368 EFFECT OF THE INTERVAL BETWEEN IRRADIATION AND CONCEPTION ON MUTATION FREQUENCY IN FEMALE MICE. Russell, W. L. (Oak Ridge National Lab., Tenn.). Proc. Natl. Acad. Sci., 54: 1552-7(Dec. 1965). (ORNL-P-1624).

Irradiation of female mice with fission neutrons has shown that the interval between irradiation and conception has a striking effect on the mutation frequency seen in the offspring. In the first seven weeks after irradiation with approximately 63 rads, the mutation frequency is high. A total of 59 specific locus mutations was observed in 80,301 offspring conceived in that period. After that, no mutations were found in a total of 120,483 offspring. There is some evidence for a similar effect with gamma irradiation. It is not yet known whether the result is due to a low mutational sensitivity of oöcytes in immature follicle stages, to an efficient repair mechanism in these stages, or to cell selection. It is not safe to assume that the results will apply to the human female, but this is certainly a possibility that should be considered in the evaluation of human data and in the estimation of genetic hazards of radiation. (auth)

18369 ON THE MECHANISM OF POLYOMA VIRUS-INDUCED SYNTHESIS OF CELLULAR DNA. Gershon, David; Hausen, Peter; Sachs, Leo; Winocour, Ernest (Weizmann Inst. of Science, Rehovoth, Israel). Proc. Natl. Acad. Sci., 54: 1584-92(Dec. 1965).

Polyoma virus can induce the synthesis of cellular DNA in x-irradiated mouse and rat embryo cell cultures. The cells almost double their DNA content after induction. A concomitant induction of histone synthesis was not observed. Nitrous acid inactivation experiments have shown that the induction of cellular DNA synthesis depends on a function of the viral genome. The rate of inactivation of the DNA-inducing capacity of the virus was similar to that found for the cell-transforming capacity. The induction of cellular DNA synthesis in rat cells was not accompanied by the detectable synthesis of infectious virions, viral antigen, or viral DNA. (auth)

18370 CELL TURNOVER IN MAMMALIAN TISSUES: USE OF CELL DEPLETION MEASUREMENTS TO CALCULATE X-RAY REPRODUCTIVE SURVIVAL CURVES IN VIVO. Puck, Theodore T. (Univ. of Colorado, Denver). Proc. Natl. Acad. Sci., 54: 1797-1803(Dec. 1965).

Further test of the theory that the principal action of ionizing radiation is to inhibit reproduction of somatic mammalian cells in vivo was carried out by analyzing depletion curves of nucleated cells of the bone marrow, thymus, and spleen of γ-irradiated mice. A simplified, formalistic model based on this theory permits establishment of a single cell survival curve for the reproductive function. Survival curves so calculated for the cells of bone marrow, the spleen, and thymus of young mice agree well with the curves obtained by direct measurement for mammalian cells generally and mouse cells specifically. Other possible applications of depletion curve analysis are indicated. (auth)

18371 LEUKEMIA IN GERMFREE RATS. Pollard, Morris; Kajima, Masahiro (Univ. of Notre Dame, Ind.). Proc. Soc. Exp. Biol. Med., 121: 585-9(Feb. 1966).

Germfree rats of 3 strains (Wistar, Fischer and Sprague-Dawley) were examined for leukemogenic potential. Particles of indefinite nature were observed only in 2 of 10 Wistar rats. Leukemia could not be induced in the rats by whole-body administered x-rays, and germfree Sprague-Dawley rats were as susceptible to Gross passage A leukemia virus as conventional rats. (auth)

18372 EFFECT OF CYSTAMINE ON THE METABOLISM OF IRRADIATED YEASTS. Botre, M.; Giovannozzi-Sermanni, G. (Univ., Rome). Progr. Biochem. Pharmacol., 1: 65-70(1965).

Results of studies on yeast showed that cystamine exhibits an influence on cell biochemistry as well as a protective effect in yeast exposed to tritium B particles. The possible relation between the biochemical and radioprotective effects of cystamine were investigated using two strains of yeast, Hansenula saturnus and H. suaveolens. H. saturnus were grown in media containing various concentrations of THO and cystamine and the effects of the filtrate from these cells on the respiratory quotients and succinic thiokinase activity of H. suaveolens grown in the filtrate were measured. The reactions of irradiated cells in the presence of cystamine were also studied. (6 references.) (C.H.)

18373 SURVIVAL AND CHROMOSOMAL ABERRATIONS IN A SYNCHRONIZED MAMMALIAN CELL CULTURE TREATED WITH 5-BROMODEOXYURIDINE AND IRRADIATED BY ULTRAVIOLET LIGHT. Djordjevic, B.; Djordjevic, Olga (Inst. of Nuclear Sciences "Boris Kidrich," Belgrade). Progr. Biochem. Pharmacol., 1: 71-7 (1965).

The effects of 5-bromodeoxyuridine (BUDR) on the sensitivity of a semi-synchronized culture of mammalian cells to ultraviolet radiation were studied. Cell survival and chromosome aberrations were used as criteria for radiation effects. The synthesis of DNA in the cells was determined autoradiographically by pulse labeling with ^{3}H-thymidine. The results are compatible with the hypothesis that BUDR sensitizes mammalian cells to uv maximally only when cell division follows incorporation of the drug. (C.H.)

18374 THE EFFECT OF GAMMA-IRRADIATION ON LIPID METABOLISM IN COTTON SEEDLINGS. Vereshchagin, A. G. (Inst. of Plant Physiology, Moscow). Progr. Biochem. Pharmacol., 1: 78-84(1965).

Results are reported from a study of the effects of 200 R γ radiation on lipid metabolism in cotyledons of cotton seedlings. The results show that ionizing radiation caused profound changes in the metabolism of fatty acids, triglycerides, and other lipid classes. (C.H.)

18375 THE EFFECT OF IONIZING RADIATIONS ON LIPID TRANSPORT. Paoletti, R.; Poggi, M.; Vertua, R.; Farkas, T. (Univ., Milan). Progr. Biochem. Pharmacol., 1: 186-202(1965).

Total-body x irradiation (1,000 R) induces a significant increase in cholesterol and triglyceride plasma levels of rats and a much more pronounced effect of the same lipid fractions in rabbits. The three possible mechanisms responsible for this type of hyperlipemia were investigated in rabbits. Increased lipid mobilization, fatty acid synthesis in the liver, or triglyceride hypersecretion to the plasma cannot be invoked as the responsible mechanisms. Data indicate a decreased peripheral utilization of triglycerides as the major cause of hyperlipemia. (27 references.) (C.H.)

18376 INFLUENCE OF THE ACTIVITY OF THE NERVOUS SYSTEM ON LATE EFFECTS OF RADIATION IN MAMMALS. Biagini, C.; Di Paola, M. (Univ., Rome). Progr. Biochem. Pharmacol., 1: 226-34(1965).

Results are reported from experiments that indicate that the following: the γ irradiation of the head can produce acute and late damages on various tissues and organs of rats. The nervous system appears to play a role in the pathogenesis of late effects of radiation in mammals. The amount of radiation damage, also when late effects of radiation are considered, appears to be influenced by the degree of activity of the nervous system. A good correlation was obtained between individual variability of behavior and late effects of radiation in rats and mice. It is emphasized that, among the different behavioral aspects submitted to analysis, those connected to the emotional behavior were mainly related to the individual variations of radiosensitivity. This appears to indicate, consistent with results obtained by other authors, that the structures of allocortex, hypothalamus, and brain stem play a more significant role, compared to the structures of neocortex, on the mechanism of the influence of the nervous system on the pathogenesis of radiation damage. (auth)

18377 THE POSSIBILITY OF INFLUENCING RADIOSENSITIVITY OF WALKER CARCINOMA IN RATS BY CYTOSTATICS ASSOCIATED WITH IONIZING RADIATION. Konecny, M.; Mechl, Z.; Svejda, J. (Cancer Inst. and Pathological Anatomical Inst., Brno). Progr. Biochem. Pharmacol., 1: 331-4(1965).

Rats bearing transplanted walker carcinomas were subjected to combined radiotherapy and chemotherapy using cytotoxic drug, Endoxan, and an antimetabolite drug, Purinetol. The tumors were exposed to 400 R x radiation at various time intervals before or after the administration of the drugs. Changes in the tumor and in other organs induced by the various treatments were determined histologically. The relation between the timing of chemotherapy and the resulting changes in the organs was also studied. The greatest changes were induced by combined therapy with Endoxan followed by irradiation, with the smallest changes induced by irradiation alone. The alterations observed in the histologic picture indicate the advisability of regional application of chemotherapeutic agents used to increase the radiosensitivity of tumors. (C.H.)

18378 PHARMACOLOGICAL INVESTIGATIONS ON CYCLOHEXANOL SUCCINATE (RADIOPLEX). Podio, G.; Rognoni, F. ("A. Fleming" Inst., Milan). Progr. Biochem. Pharmacol., 1: 352-8(1965).

The pharmacological properties of a new radiosensitizer sodium cyclohexanolsuccinate (Radioplex), are reported. The results regarding the acute and chronic toxicity of this agent, its teratogenic action, and influence on the various organs and apparatuses are reported. (auth)

18379 EXPERIMENTAL INVESTIGATIONS ON RADIOPHOSPHORUS UPTAKE IN IRRADIATED RATS; THE EFFECT OF RADIOSENSITIZERS. Dragoni, G. (Univ., Milan). Progr. Biochem. Pharmacol., 1: 377-83(1965).

The radiosensitizing effect of synkavite and cyclohexanol on the incorporation of radioactive phosphorus in the kidney and liver of rats subjected either to whole-body x irradiation or to irradiation of the kidney was studied. Irradiation causes an increase in ^{32}P uptake by the tissues, an effect which is potentiated by the radiosensitizers studied. The histologic and radioautographic findings on renal and hepatic tissue are also described. (auth)

18380 THE INTERACTION OF AMPHETAMINE AND LOW DOSE IRRADIATION. Barnes, C. D. (Indiana Univ., Bloomington). Progr. Biochem. Pharmacol., 1: 568-73 (1965).

The interactions of amphetamine (benzedrine) and low-dose x radiation were investigated in mice. Results showed that low dose irradiation sensitized the mice to the toxic effects of amphetamine. Possible reaction mechanisms involving the brain and central nervous system are discussed. (C.H.)

18381 CONTROL OF THE DAMAGE AND THE RECOVERY OF THE GRANULOPOIESIS AFTER IRRADIATION. Sacchetti, C.; Morra, L.; Boccaccio, P.; Ponassi, A. (Univ., Genoa). Progr. Biochem. Pharmacol., 1: 642-50(1965).

The evaluation of the granulopoiesis in man was performed by means of the mobilization of the bone marrow reserve and by the in vivo labeling of the granulocytes with ^{32}P diisopropylfluorophosphate. Ten subjects were studied before and after x irradiation with a dose of 3,500 R on the median thoracic area. When irradiation was stopped granulocytopenia, with depletion of the bone marrow was observed. Thirty days after irradiation all the patients showed a normal count of granulocytes in the blood, but only in 4 cases a normal bone marrow reserve was found. The necessity of evaluating the real conditions of granulopoiesis on the basis of the bone marrow reserve is emphasized. (auth)

18382 RADIOSENSITIVITY OF MELLE-PASTURE TYPE PERENNIAL RYE-GRASS SEEDS (LOLIUM PERENNE) AT DIFFERENT MOISTURE LEVELS IN RELATION TO WAVELENGTH AND WITH OR WITHOUT A PRE-GERMINATION STORAGE PERIOD. De Loose, R. (Government Plant Breeding Station, Lemberge, Belgium). Radiat. Bot., 6: 1-6(Feb. 1966).

Melle-pasture type perennial ryegrass seeds (Lolium perenne: a crossfertilizer) were subjected, after equilibration to 4 different moisture levels, to acute x rays (90 kvp–4 mA: 2000 rad/min) and semi-chronic ^{60}Co γ rays (25 rad/min) with the same total energy dissipation in the tissues. For each moisture level a survival dose curve was constructed. The percentage survival of the seedlings after 4-weeks growth in a Knop's nutrient solution was used as a criterion of radiation damage. A definitely higher potency of the semi-chronic γ-ray treatment of dry seeds (water-contents respectively: 4.60 and 6.65%) could be observed by germinating them immediately after irradiation as well as with a 3-week storage period prior to germination. However with moist seeds (water-contents respectively: 14.24 and 16.93%) the same total amount of damage for both radiation sources could be observed, by germinating them immediately as well as with a 3-week storage period. Thus the differential effect immediately

as well as after storage with dry seeds really represents a difference in the potency of the two sources. As with dry seeds the indirect action of both radiations is at work, the cause of this differential action should be sought in a possible quenching effect of excited molecules either because of the higher dose rate of acute x rays, or simply because of the higher LET value of 90 kvp x rays (100 ion pairs/μ) over ^{60}Co γ rays (8 ion pairs/μ). The differential LET-value seems to play no role in the direct action with moist seeds. (auth)

18383 A COMPARATIVE STUDY OF THE EFFECTS OF GAMMA RADIATION ON ORGANIZED AND DISORGANIZED GROWTH OF TOBACCO. Venketeswaran, S.; Partanen, C. R. (Univ. of Pittsburgh). Radiat. Bot., 6: 13-20(Feb. 1966).

A comparative study of the effects of gamma radiation was carried out on young seedlings of tobacco in culture and callus tissue of tobacco grown in suspension culture. A striking difference in radiosensitivity was observed between the two types of growth, viz., organized vs disorganized growth. Low doses of 650 and 1300 R produced certain initial morphological effects on seedlings like stunting leaf growth and injuring certain cells of the apical meristem; but as the seedlings were allowed to grow for 80 days in culture, these early morphological effects disappeared and a stimulation in growth of seedlings was evident at these low doses. A dose of 5200 R stopped completely the growth of the apical meristem. In comparison, at low doses up to 1300 R, callus growth was slightly reduced and only doses around 10,400 R produced any adverse decrease in growth of callus tissue, with some callus tissues surviving even after a dose of 20,800 R. This difference in radiosensitivity between the meristem of normal seedlings and the callus tissue can be interpreted to be analogous to a closed system vs. an open system; i.e., the apical meristem representing a closed system where the small number of meristematic cells present at the apex are all diploid (with no endopolyploidy occurring) and under the influence of the organizational environment of the intact plant. On the other hand, callus tissue will represent an open system where the disorganized proliferating cells are friable, noncoherent and free from each other with a large number of cells in various levels of ploidy. The results are discussed in the light of these observations. (auth)

18384 THE CORRELATION OF INTERPHASE CHROMOSOME VOLUME WITH POLLEN ABORTION INDUCED BY CHRONIC GAMMA IRRADIATION. Yamakawa, K.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot., 6: 21-38(Feb. 1966). (BNL-9548).

The effects of chronic gamma irradiation on pollen abortion were observed in Arabidopsis thaliana, Antirrhinum majus, Lycopersicum esculentum, Nigella damascena, and Tradescantia paludosa, representing a wide range of radiosensitivity as predicted by their interphase chromosome volumes (ICV). Pollen abortion was increased most drastically in the period from the differentiation of pollen mother cells to the end of meiosis, termed the pollen-sensitive period. The regression of daily exposures producing 50 per cent pollen abortion against ICVs of shoot meristematic cells showed a distinct correlation between sensitivity and chromosome size when both values were plotted in logarithm scale, but the slope (−1.426) indicated that the relationship is not purely proportional but that cells with large chromosomes were more sensitive than had been expected from the −1 slope, and those with small chromosomes more resistant than expected. The duration of the pollen-sensitive period was longer for plants with large nuclei than for plants with small nuclei, and when this was corrected and the total exposures accumulated within this period were plotted against ICVs, a clear regression curve with a slope of −1.098 was obtained. This fitted slope is not significantly different from −1. A radiobiological constant for 50 per cent pollen abortion was developed from the regression equation based upon a slope of −1. From this relationship certain radiobiological responses can be calculated (or predicted) for other species of higher plants. (auth)

18385 THE INDUCTION OF EARLY FLOWERING MUTANTS IN CORCHORUS OLITORIUS L. Basu, Rabindra Krishna (Bose Inst., Calcutta). Radiat. Bot., 6: 39-47 (Feb. 1966).

From the x irradiated and ^{32}P treated populations of two varieties of jute, Corchorus olitorius, mutants were isolated which on average flowered earlier than the control and had greater plant to plant variation. The earliness of 79 days in a x-ray-induced mutation and of 81 days in a ^{32}P-induced-mutation in mean time of flowering over their respective controls is remarkable. The early mutants had long flowering periods. Evidence has been presented to show that earliness was associated with reduction in node number at first flowering. Four early mutants were superior to the control in yield of seed per plant, in addition to good quality fibre extracted from them. The ultimate plant height and the time taken for first flowering were found to be negatively correlated. (auth)

18386 WINTER ANNUAL VEGETATION FOLLOWING A NUCLEAR DETONATION IN THE NORTHERN MOJAVE DESERT (NEVADA TEST SITE). Beatley, Janice C. (Univ. of California, Los Angeles). Contract AT(04-1) Gen-12. Radiat. Bot., 6: 69-82(Feb. 1966).

Winter annual vegetation and environmental phenomena were observed and measured through the growing seasons of 1962 to 65, on 3 sites in northeastern Yucca Flat within 2 miles of the Sedan underground thermonuclear detonation in July 1962. Cumulative γ radiation recorded was of the magnitude of 4000 to 13,000 R. As a result of the regional precipitation regime in the autumn of 1962, there were no winter annuals present in the Sedan area, or in most other parts of the Test Site, during the growing season 1962 to 63. Seedlings of the first post-Sedan populations, which appeared following September 1963 rains, were the largest and most vigorous of populations observed in any region of the Test Site. The exceptional size and vigour continued through the period of anthesis in May 1964, and were corroborated by measurements of average height, cover, biomass and survival of the spring populations, as compared with those on seven other sites in central and northern Yucca Flat. In the next generation, which germinated in the spring of 1965 following record precipitation (4 to 5 in.), there was neither higher survival of the Sedan populations nor exceptional development at any stage during the several-week growing season. The unusual vigour of the winter annual populations in the 1963- 64 season is inferred to have been in part a stimulatory effect of the ionizing radiation to which the embryos in the seeds were exposed from July 1962 until time of germination in September 1963. Abnormal morphological development of frequent individuals of Chaenactis stevioides, the dominant winter annual on the Sedan sites, may also have been an effect of seed irradiation. (auth)

18387 A TEST FOR A MAGNETIC EFFECT IN IRRADIATED SEEDS. Conger, A. D. (Temple Univ. School of Medicine, Philadelphia); Flasterstein, A. H.; Thompson, K. Radiat. Bot., 6: 105-9(Apr. 1966).

A magnetic effect on radiation damage in seeds was sought. Dry dormant barley seeds were x-irradiated, and exposed to uniform permanent magnetic fields (4 to 10 kG) or to dummy magnets (no magnet) in dry air at room temperature. Seeds were exposed in three experiments to magnetic fields for: 1 day post irradiation; during irradiation and for 4 days post irradiation; and during and for 4 days post irradiation and during the 2-hr period of water soaking to start germination. These are periods during which many other modifiers profoundly affect radiation damage, and when radiation-induced free radicals are present in the seeds. Seeds were grown for about 10 to 12 days, and height of the first leaf (the well-known seedling height) used as criterion of radiation damage. Seedling height was not affected by the magnetic treatments. (auth)

18388 MAGNETIC FIELDS AND IONIZING RADIATION: EFFECTS AND INTERACTIONS DURING GERMINATION AND EARLY SEEDLING DEVELOPMENT. Mericle, R. P.; Mericle, L. W.; Montgomery, D. J.

(Michigan State Univ., East Lansing). Radiat. Bot., 6: 111-27(Apr. 1966).

Experiments utilizing ionizing radiation and magnetic fields, alone and in combination, were carried out for the purpose of comparing the effects of and ascertaining the interactions between acute 50,000 R x-irradiation of dormant barley grains and continuous application of a 3000 G steady homogeneous magnetic field during subsequent germination and early seedling development. X-irradiation alone produced the familiar effects. Germination in the homogeneous magnetic field caused, by itself, only small, consistent, but statistically insignificant growth inhibition, accompanied by significant increases in variability. Effects on root number, emergence, and intra-embryonic size correlations, however, equalled or exceeded those produced by the radiation. When applied as a post radiation treatment, the magnetic field reduced the radiation effects on growth and root number. As with magnetic effects per se, the degree to which the magnetic field attenuated the radiation damage exhibited in any particular criterion was inversely correlated with the level of radiosensitivity possessed by that criterion. In addition, radiation-induced reductions in variability were lessened by the presence of the magnetic field, and alterations in intra-embryonic correlations, reversed. Synergistic interactions occurred between radiation and magnetic field with regard to the rate of emergence. The homogeneous magnetic field produced its largest effects and greatest attenuation of radiation damage (or the opposite, synergistic interactions) upon those aspects of seedling development that were least radiosensitive and most dependent upon cell enlargement for expression. This suggests that the biomagnetic effects observed must be mediated through physiological processes other than those of primary concern in producing radiation damage. (TCO)

18389 THE INFLUENCE OF SEED WATER CONTENT ON THE OXYGEN EFFECT IN IRRADIATED BARLEY SEEDS. Conger, B. V.; Nilan, R. A.; Konzak, C. F.; Metter, S. (Washington State Univ., Pullman). Radiat. Bot., 6: 129-44(Apr. 1966). (TID-21975).

Himalaya barley seeds were brought to eleven different water contents, ranging from 2 per cent (very dry) to 14 per cent (moist), by storage at various constant humidities. The seeds were then placed in glass vials that were evacuated and sealed while still under vacuum. They were irradiated with a 5500 C ^{60}Co γ-ray facility and hydrated in oxygen- or nitrogen-saturated water. The magnitude of the oxygen effect at different seed water contents was measured in terms of oxygen-effect factors. Oxygen-effect factors, as measured by injury (reduction in M_1 seedling growth), increased from 1 to 9 as seed water content decreased from 12.7 to 2.5 per cent. In very dry seeds (2.1 per cent water content) oxygen-effect factors of 10 for injury, of 15 for chromosome aberrations, and of 10 or higher for mutation frequencies were obtained. The response to oxygen rehydration of irradiated seeds with a low (4 per cent and lower) or with a high water content (12 per cent and above) showed little or no change during a two-week storage period in sealed evacuated vials. However, seeds with a medium water content, particularly about 10 per cent, exhibited a marked oxygen response at the beginning of the storage period but a very reduced response after 2 or 4 weeks storage. In these seeds the electron spin resonance signal amplitude decreased significantly and in a fashion parallel to the decrease in oxygen sensitivity. The results reveal that some of the damage in irradiated seeds may be initiated by interactions between oxygen and radiation-induced radicals. The lifetime and behavior of the radicals and the behavior of oxygen depend on the seed water content. (H.G.D.)

18390 INTERACTION OF RADIATION AND PHOTOPERIODISM IN XANTHIUM CHINENSE: EFFECTS OF VARIATION IN TIME OF RADIATION WITH RESPECT TO PHOTOINDUCTION. Brown, G. N.; Taylor, F. G. Jr. (Oak Ridge National Lab., Tenn.). Radiat. Bot., 6: 145-50 (Apr. 1966). (ORNL-P-1708).

Groups of Xanthium chinense plants received a dose of 5125 rads ^{60}Co γ radiation before, during, and after short day photoinduction. Another group of plants received 5125 rads, but was kept on long days. Two groups of non-irradiated control plants were either photoinduced or kept on long days. Flowering was not significantly altered in plants irradiated before photoinduction, was permanently suppressed in plants irradiated during photoinduction, and was temporarily enhanced in plants irradiated after photoinduction. None of the long day plants flowered. Stem elongation and leaf production were enhanced in plants irradiated before, during, and after photoinduction. Increases in vegetative growth patterns also were observed in irradiated long day plants. (auth)

18391 EFFECTS OF ULTRAVIOLET RADIATION ON THE LEAVES OF HIGHER PLANTS. Cline, M. G.; Salisbury, F. B. (Colorado State Univ., Fort Collins). Radiat. Bot., 6: 151-63(Apr. 1966).

The lethal effects of germicidal ultraviolet (λ = 2537 Å) on the leaves of 67 species of plants were studied. A smaller number of species were examined under the simulated extraterrestrial solar radiation of a Xenon lamp at a wide range of intensities. Delicate broad-leaved plants were among the most sensitive plants tested, and tough-leaved xeromorphoric plants were among the most resistant. Grasses were moderately resistant, whereas most garden vegetables were quite sensitive. Pinus nigra that was subjected to simulated solar radiation at an intensity (0.86 cal/cm^2/min) equivalent to that above the atmosphere of Mars for 44 consecutive days (635 hr) sustained very little uv damage. A prolonged pre-treatment with sublethal and near-lethal exposures of radiation in Xanthium leaves caused an accumulation of damage and an increase in sensitivity to a final lethal exposure. Photoreversal of uv damage was found in Xanthium both with uv alone (germicidal lamp) and with uv in conjunction with high-intensity visible radiation (Xenon lamp) when followed by an exposure of visible radiation. (TCO)

18392 PHOTOREACTIVATION OF ENDOSPERM MUTATIONS INDUCED BY ULTRAVIOLET LIGHT IN MAIZE. Ikenaga, M.; Mabuchi, T. (National Inst. of Genetics, Misima, Japan). Radiat. Bot., 6: 165-9(Apr. 1966).

Changes in relative mutation frequencies in maize endosperm were studied after visible light treatment of uv or γ-irradiated pollen grains. For the uv-irradiated groups, mutation frequencies of whole endosperm mutants were considerably decreased by post treatment with visible light, while the frequencies of partial mutations (chimeras) were slightly increased by the treatment. By a similar post treatment of γ-irradiated pollen the mutation frequencies were not modified. (auth)

18393 THE EFFECT OF DESICCATION, STORAGE, AND RADIATION INTENSITY ON MUTATION RATE IN TOMATO POLLEN. Brock, R. D.; Franklin, I. R. (CSIRO, Canberra, Australia). Radiat. Bot., 6: 171-9 (Apr. 1966).

The frequency of mutations at three loci induced by γ-irradiation of tomato pollen was measured under various conditions of desiccation, storage, and radiation intensity. While a sixfold difference in mutation rate per rad per locus, at LD_{40} doses, was obtained when dried pollen given chronic γ-irradiation was compared with fresh pollen given acute γ-irradiation, this difference proved to be largely the result of changes in radiation sensitivity of the pollen. Radiation sensitivity and mutation rate were influenced to a major extent by desiccation and to a lesser extent by ageing of pollen. Most of the mutations observed appeared to result from deletions rather than point mutations. (auth)

18394 LEUKOCYTE TEST IN RAT OBSERVATIONS ON RELIABILITY, SENSITIVITY, AND UTILIZATION IN RADIOBIOLOGY. Martinenghi, C.; Castellano, E.; Riccardi, A.; Baraldi, C. (Univ., Milan). Radiobiol. Radioterap. Fis. Med., 20: 252-60(July-Aug. 1965). (In Italian).

In an attempt to estimate the reliability and sensitivity of the leukocyte test in radiobiology, the fluctuations in the number of leukocytes and of their main fractions (lymphocytes and granulocytes) were studied in basal conditions

and after pan-irradiation in rats. From analysis of the results and study of the correlations existing between number of observations, scatter of the counts, and confidence limits of the mean, it was concluded that significant statistical differences less than 20% of the normal value of leukemia observed are obtainable with a limited number of observations. An increase in the statistical scatter may also be a sign of a pathological condition. (auth)

18395 EFFECTS OF X RAYS ON THE PROLIFERATIVE CAPACITY OF ISOLATED CARROT ROOT TISSUE CELLS. Naito, Tadao; Yamaguchi, Kikoyuki (Tokyo Univ.). Radioisotopes, 15: 83-8(1966).

Tissues excised from carrot root were x irradiated and were cultivated in vitro. Fresh weight, DNA, RNA, or protein content were measured during 21 days after irradiation. The increase of DNA amount was not found, while fresh weight and protein content increased during 21 days. Histological observation demonstrated that there were no meristematic regions and the cells enlarged and became conspicuously vacuolate. (auth)

18396 ON THE BIOLOGICAL EFFECTS OF ROENTGEN RADIATIONS OF 180 kev AND FAST ELECTRONS OF 30 Mev IN TRANSPLANTED TUMORS OF WHITE MICE. Paolini, Francesco Antonio (Univ., Zurigo, Italy. Univ., Pavia, Italy). Radiol. Med., 51: 1218-36(Nov. 1965). (In Italian).

Qualitative and quantitative analyses of Ehrlich's adenocarcinoma transplanted in the muscle tissue of white mice and irradiated with 180 kev x rays and 30 Mev fast electrons are reported. From the qualitative point of view, there were no substantial differences in the response to irradiation. By contrast, the quantitative aspect revealed greater effectiveness of x rays compared with fast electrons, at equal radiation doses. It is suggested that the biological effectiveness ratio between the two types of radiations assumes different values not only for the various tumor forms but also according to other variables in the same tumor. (auth)

18397 ON THE POSSIBILITY OF THE ONSET OF MALIGNANT NEOPLASMS FOLLOWING ROENTGEN-CASTRATION FOR UTERINE MYOFIBROMAS AND OTHER BENIGN GYNECOLOGICAL AFFECTIONS. Blandino, G.; Micali, A.; Minutoli, A.; Scolarici, L. Radiol. Med., 51: 1302-18(Dec. 1965). (In Italian).

Malignancy of the pelvic organs was observed in only one out of 86 patients undergoing radioinduced ovarian castration. Only 3 out of 971 patients suffering from malignant tumors of the pelvic organs had previously undergone ovarian radiocastration. It is concluded that the alleged carcinogenic action of correctly performed radiocastration has not been proven. (auth)

18398 HYPOPLASIA OF THE ABDOMINAL AORTA FOLLOWING THERAPEUTIC IRRADIATION IN INFANCY. Colquhoun, Joseph (Texas Children's Hospital, Houston, Tex.). Radiology, 86: 454-6(Mar. 1966).

On long-term follow-up studies after irradiation of the renal areas for malignant tumor in infancy, two children were found to be hypertensive; aortograms showed hypoplasia of the abdominal aorta and renal artery stenosis. The findings suggest that radiation effects on the major blood vessels during the growth period may be of more serious consequence than has been supposed previously. (auth)

18399 BINUCLEATED LYMPHOCYTES IN THE BLOOD OF INDIVIDUALS IRRADIATED WITH A SMALL DOSE. Roy-Taranger, M.; Mayaud, G.; Davydoff-Alibert, S. (CEN, Fontenay-aux-Roses, France). Rev. Franc. Etud. Clin. Biol., 10: 958-65(Nov. 1965). (In French).

The incidence of binucleate lymphocytes in the blood of normal individuals and that of patients exposed to doses of 20 rads or 50 rads γ radiation was compared. The incidence in normal individuals was about $1.36/10^4$, while in persons exposed to 20 rads the incidence ranged between 4 and $13/10^4$ lymphocytes by the second week and in persons exposed to 50 rads the incidence was 6 to 32 binucleated lymphocytes/10^4 lymphocytes by the second post-exposure week, followed by a decline in number during the third week. It is suggested that the incidence of binucleated lymphocytes may be used as a diagnostic test of low-level radiation exposure where other hematological values remain normal. (C.H.)

18400 THE APPLICATION OF GAMMA IRRADIATION INSTALLATIONS TO THE TREATMENT OF PLANTS. Aufhammer, G.; Fischbeck, G.; Haisch, A. (Technische Hochschule, Munich). Schriftenreihe Bundesmin. Wiss. Forsch., Radionukl., No. 3, 1-78(1965). (In German).

On the basis of the information available, a comprehensive survey was made of the construction, operation, and functional range of the existing gamma irradiation installations for the treatment of living plants. The results obtained with these installations are summarized. (140 references.) (J.S.R.)

18401 CLINICAL SIGNS AND PHYSIOLOGICAL OBSERVATIONS IN THE GOAT FOLLOWING FRACTIONATED GAMMA RADIATION. Szabuniewicz, Michael; Hupp, Eugene W.; Davis, Richard H. Jr.; Brown, Sidney O. (Texas A and M Univ., College Station). Southwestern Vet., 17: 305-14(Summer 1964).

This investigation was designed to determine the effects of nine weekly doses of 104 rad of γ radiation followed by a single dose of 800 R on the male Spanish goat. This study was concerned with clinical manifestations of radiation injury and changes in the electrocardiogram, electroencephalogram, heart rate, respiratory rate, and body temperature. No clinical symptoms of radiation sickness were observed during the first 9-week period of irradiation, and no major changes were noted in any components of the electrocardiogram and electroencephalogram (EKG and EEG) except for a slight increase in amplitudes of the QRS complex and the T wave. When, on the tenth week, the four previously irradiated goats were given a single dose of 800 R, it proved lethal for all four animals. Survival times ranged from five to 18 days. Clinical symptoms of radiation sickness were not prominent until the final three to four days of life. At this time all goats developed pronounced tachycardia, fever, diarrhea, weakness, depression, and dyspnea and were prostrate at the time of exitus. The amplitude of all components of the EKG increased steadily with the most pronounced changes occurring in the QRS complex. Changes in the EEG, obtained by a single transparietal lead, did not occur until the later stages and consisted principally of slowing of electrical activity. Evoked cortical responses diminished progressively and could not be elicited one to two days prior to death. (BBB)

18402 ON THE MORPHOLOGICAL AND FUNCTIONAL CHANGES IN THE ADRENAL CORTEX CAUSED BY IONIZING RADIATION IN SUPRALETHAL DOSES. Kovacs, Laszlo (Medizinisch-Radiologische Forschungsinstitut, Ungarische Akademie der Wissenschaften, Budapest). Strahlentherapie, 129: 238-51(Feb. 1966). (In German).

Morphological and functional changes in the adrenal cortex, produced by supralethal doses of ionizing radiation were investigated in albino rats. A close correlation exists between intensity of the hormone secretion and the lipoid content of the adrenal cortex. A high hormone level in the blood after irradiation correlates with a low lipoid content of the adrenal cortex. The lowest level of blood hormone and the highest lipoid content of the adrenal cortex were observed 24 hours after irradiation. In the terminal phase, there was a low lipoid content of the adrenal cortex and a high blood corticoid level. Quantitative variations within the different lipoids at different times after irradiation are not characteristic. (auth)

18403 EFFECTS OF 200-R X WHOLE-BODY IRRADIATION ON THE CYCLE AND ESTRUS OF LABORATORY MICE IRRADIATED ON THE 15TH DAY OF PREGNANCY IN UTERO. Teichelmann, Helmut; Trautmann, Johannes (Staedt. Krankenhauses Moabit, Berlin). Strahlentherapie, 129: 252-7(Feb. 1966). (In German).

Mouse embryos were given 200 R whole-body x-irradia-

tion on the 15th day of gestation. Observations made from in utero irradiation of the fetus until the appearance of puberty showed that pathological changes in the estrus cycle were almost double those of the control. The cycle was more radiosensitive to exposure in utero than in the adult female. Reproductive behavior was not affected. (tr-auth)

18404 THE SINGLE ONE-SIDE IRRADIATION OF PREGNANT MICE BY A NEW EXACT METHOD OF EXPERIMENTAL TERATOLOGY. PRELIMINARY REPORT. Ostertag, Berthold; Schau, Hans Joachim; Wellmann, Eckard (Univ., Tuebingen, Ger.). Strahlentherapie, 129: 258-62(Feb. 1966). (In German).

The experimental design for irradiating only one uterus horn of the uterus bicornis in pregnant mice is described. In order to obtain different radiation qualities, the apparatus has to be changed. Results are reported, which permit for the first time the exact comparison of the changes obtained in the members of the same litter (irradiated and non-irradiated). The importance for teratology and embryology is discussed. (auth)

18405 WHICH BIOLOGICAL MECHANISMS FORM THE BASIS FOR RADIATION DEATH OF CELLS? Laskowski, W. (Freie Univ., Berlin). Umsch. Wiss. Tech., 64: 42-6(Jan. 15, 1964). (In German).

It is generally known that for destruction of cells in malignant tumors energetic radiation is required, but the exact bases for the effects are not known. Genetic factors in the chromosomes or the cell plasma may be radiosensitive. A straight-forward answer to whether lethal changes are produced in the genetic constituents of the cell by radiation can be obtained only by means of simple or multiple studies on cells that can be reproduced or decreased as needed. Certain yeast cells are suitable for these purposes. Developmental phases of polyploidal strains of Saccharomyces were studied. Recessive and dominant lethal mutations and plasmatic lethal effects were measured. The relative resistance of Saccharomyces strains with various chromosomal compositions to x irradiation and uv irradiation was measured. The survival of a haploid and diploid Saccharomyces strain after exposure to x rays, irradiation from Po, He, C, and O atoms from a linear accelerator, and uv light was studied. The fractions of recessive lethal mutations, dominant lethal mutations, and nonchromosomal plasmatic lethal effects that resulted were compared. Relations of radioinduced mutation rates to radiation injuries of genes are discussed. (BBB)

18406 ON INJURIES TO THE CERVICAL SPINAL CORD FOLLOWING X IRRADIATION. Weingarten, K. (Univ., Vienna). Wien. Z. Nervenheilk. Grenz., 21: 203-22(Jan. 2, 1964). (In German).

The authors report two cases of radioinduced cervical myelopathy verified on autopsy, and one not verified by autopsy. In the first case the patient had been x irradiated in two lateral jaw-neck and two neck fields of 3000 R each, for lymphoepithelioma of the left epipharynx that had metastasized to the regional lymphatics. The focal dose administered amounted to 5500 to 6000 R. The tumor was cured, but two years later the patient experienced progressive loss of sensory feeling in arms and legs, weakness, and finally tetraplegia. The second patient was x irradiated with 6800 R in the cervical region for laryngeal carcinoma, and died 9 years later from brain embolism. In these patients numerous injuries of the cervical spinal cord were found. In one, radioinduced bilateral thromboses of the internal carotids and of the right external carotid were found. The neurological symptoms of radiomyelopathy of the cervical spinal cord are characteristic. The initial symptoms are misleading and simulate extramedullary processes, such as those in the dorsal spinal cord. The authors discuss the neurological and histological bases of the cases reported and present theoretical aspects of the development of the irradiation injuries observed. The problems associated with estimation of a tolerance dose for the central nervous system are considered. References cited, 43. (BBB)

18407 OSTEORADIONECROSIS OF THE FEMUR NECK. Klug, W. (Bezirkskrankenhaus, Dresden). Zentralbl. Chir., 90: 68-72(Jan. 19, 1965). (In German).

Development of osteoradionecrosis of the femoral neck following x-ray therapy for gynecological carcinomas is described. Prognosis for the fracture is good, but depends on the status of the primary tumor. Treatment is the same as that for a traumatic fracture. (H.G.D.)

18408 THE STATE OF SMALLPOX IMMUNITY IN RABBITS IN CONDITIONS OF PRIMARY AND REPEATED X-IRRADIATION. Kamalyan, L. A.; Ter-Pogosyan, R. A.; Engoyan, M. N. (Radiobiology Div., Academy of Medical Sciences, Erevan). Zh. Mikrobiol. Epidemiol. Immunobiol., No. 2, 71-4(Feb. 1966). (In Russian).

X-irradiation (500 R) caused a temporary depression of smallpox immunity. Preliminary irradiation in animals created a definite resistance to repeated irradiation in a dose of 1,000 R. A previously acquired intensive smallpox immunity was not disturbed after repeated irradiation. (auth)

18409 RADIATSIYA I SELEKTSIYA RASTENII. SBORNIK STATEI. (Radiation and Selection of Plants. Collection of Articles). Dubinin, N. P. (ed.). Moscow, Atomizdat, 1965. 206p.

Twenty-three articles are included on results of experiments in the use of ionizing radiation for the selection of agricultural plants. Discussions are given on radiation and chemical mutagens, results of irradiating seeds and pollen, methods for estimating the value of mutants produced, and the use of mutants in selection work. Data on winter and spring wheat, wheat-couch-grass hybrids, barley, corn, peas, vegetables, tomatoes, potatoes, sunflowers, cotton, grapes, and trees are presented. (M.J.T.)

18410 THE RESPONSES OF DROSOPHILA MELANOGASTER TO WEAK ELECTROMAGNETIC FIELDS [Thesis]. Picton, Harold David. Evanston, Ill., Northwestern Univ., 1964. 68p.

An investigation was made of the orientational responses of Drosophila melanogaster to weak electromagnetic fields. Magnetic, electrostatic and gamma radiation fields with intensities similar to natural fields were used. The findings are based on an analysis of 109,285 individual fly observations accumulated during 2,286 replicate runs. The magnetic fields were shown to influence the degree of turning, the variability of the data, the activity, the phototactic responses and the lunar rhythms of response of the flies. Similar findings were made for the electrostatic and gamma radiation fields. The gamma radiation gave the fewest number of significant responses. All of the fields appeared to have a phasing influence on some of the rhythmic lunar month responses. Combinations of fields tended to give responses more similar to those of the controls than did the single factor fields. The modification of the lunar patterns of response by the experimental conditions is discussed in relation to the biological clock problem. Results were compared with those of similar studies on other organisms. (TCO)

18411 IRRADIATION IN SUCCESSIVE GENERATIONS: COMPARATIVE RESPONSES OF DEVELOPING AND DORMANT EMBRYOS [Thesis]. Campbell, William Frank. East Lansing, Mich., Michigan State Univ., 1964. 238p.

Experiments were designed to: study the effects on the germ line of Hannchen barley following the application of recurrent irradiation to each of one, two, and three successive generations at specific stages of embryogeny and at dormancy; to compare the responses of seedlings and mature plants arising from these embryos irradiated either during their embryonic development or at dormancy; and to determine if Hannchen barley (a diploid, two-rowed variety) possesses the potentialities for the induction of radiation resistance or susceptibility. Results strongly indicate that when measuring radiation sensitivity careful consideration should be given the criterion used as an index of effect. In addition, the ontogenetic stage of irradiation development should receive special attention. Overall, increased seedling vigor (as measured by shoot height) and survival to

maturity, following the third successive generation of radiation given both developing and dormant embryos, suggests that the Hannchen germ line is capable of adapting to irradiation as an additional environmental stress. This appears to be accomplished by an alternating cycle, initially a build-up of the genetic burdens in one generation followed by their elimination in a subsequent irradiated generation. Furthermore, from the data obtained in this study, it does not appear feasible to use recurrent irradiation, during successive generations, to increase and retain the frequency of mutations in this diploid variety of barley mainly because of its high level of discrimination (through haplontic and/or diplontic selection) against these induced mutations. (TCO)

18412 NEOPLASIA IN CHILDREN IRRADIATED FOR THYMIC ENLARGEMENT: A TEN-YEAR FOLLOW-UP REPORT. Hempelmann, Louis H.; Toyooka, Edward T.; Pifer, James W. (Univ. of Rochester, N. Y.). 12p. (CONF-651060–7). ORAU. Gmelin, AED-CONF-65-318-9.

From American Public Health Association, 93rd Annual Meeting, Chicago.

The relationship between radiation exposure and the subsequent development of neoplastic disease was studied in two populations: a group of about 3000 children treated with x rays in infancy for thymic enlargement; and a population of about 1000 patients given x-ray therapy to the head, primarily for lymphoid hyperplasia of the nasopharynx. In the group treated for thymic enlargement over three times as many cancers were observed as expected, and the number of thyroid tumors was over 20 times as large as that expected. In addition, the clustering of tumors in the treated tissues and the excessive number of neoplasms associated with the use of anterior and posterior ports strongly suggest that x-ray exposure was the etiologic agent. Because of the limited data, a dose-response relationship was not demonstrable. The majority of neoplasms occurring in children treated for lymphoid hyperplasia were found in the large fields. Data in the latter group support the hypothesis that simultaneous exposure of both the pituitary and thyroid glands enhance carcinogenesis in the thyroid. It is predicted that additional tumors will develop in both groups in the years ahead. (H.G.D.)

18413 MUTATIONS IN QUANTITATIVE TRAITS. REPORT OF SYMPOSIUM HELD ON JULY 28 TO 29, 1964. Gamma Field Symp., No. 3, 1-150(1964). (CONF-640714).

Separate abstracts were prepared on eight papers presented at this symposium. (C.H.)

For abstracts of individual papers see: 18414–18421.

18414 SOME CONSIDERATIONS ON GENE MUTATIONS AND THE GENETIC BACKGROUND. Oka, Hiko-Ichi (National Inst. of Genetics, Misima, Japan). Gamma Field Symp., No. 3, 1-11(1964).

Seeds of rice were exposed to 12,000 R x radiation and progeny were analyzed for abnormal spikelets. An examination of results led to the conclusion that the undesirable effects of a mutant gene may be mitigated by changing the genetic background and that this is important for plant breeding. (C.H.)

18415 POLYGENIC MUTATIONS AFFECTING QUANTITATIVE CHARACTERS OF DROSOPHILA MELANOGASTER. Mukai, Terumi (National Inst. of Genetics, Misima, Japan). Gamma Field Symp., No. 3, 13-29(1964).

Results are reported from a study of spontaneous and x-ray induced polygenic mutations that affect the quantitative characters of Drosophila melanogaster. The evolutionary significance of polygenic mutations in natural populations and their possible application in animal and plant breeding programs are discussed. (30 references.) (C.H.)

18416 MUTATIONS INDUCED WITH RADIATIONS IN THE HEADING DATE OF RICE. Yamagata, Hirotada (Kyoto Univ.). Gamma Field Symp., No. 3, 31-47(1964).

Dry seeds of rice exposed to 5 to 30 kR γ radiation and plants at several developmental stages from five weeks to a few days before heading were exposed to 1 to 15 kR x radiation. The progenies of x_2 plants with aberrant heading dates, as well as a number of x_2 plants with normal heading dates, were grown as separate lines. Some of the families derived from the irradiated plants were genetically analyzed as to segregations in the progenies of mutants and the results from the crosses of fixed mutant lines to the original variety or strain, or to another mutant line. Results suggest that irradiation is an effective method for the induction of polygenic mutations of heading date in rice. (C.H.)

18417 MUTATIONS INDUCED IN QUANTITATIVE CHARACTERS IN RICE AND OATS. Okabe, Shiro (Hokkaido Agricultural Experiment Station, Sapporo). Gamma Field Symp., No. 3, 49-58(1964).

Dry seeds of a pure line of rice were exposed to 20 kR and 10 kR doses of ^{60}Co γ radiation. Several types of mutations with a catastrophic effect were produced in the x_2 generation. The deleterious mutants including albinos and sterility were rejected in the x_2 generation and no such undesirable mutants could be seen in x_3 and later generations. Two hexaploid oat varieties were treated with 1.29×10^{13} neutrons/cm^2 and primary and secondary caryopses of oat lines derived from irradiated and non-irradiated varieties were subjected to component analysis of variance of selected characteristics. Results indicate that component analysis of quantitative characters in irradiation-derived populations has practical usefulness in plant breeding programs and also may help in understanding the mechanisms responsible for irradiation-induced variation. (C.H.)

18418 SELECTION IN MUTATION BREEDING OF BARLEY. Takeda, Genkichi (Shikoku Agricultural Experiment Station, Zentsuji, Japan). Gamma Field Symp., No. 3, 59-73(1964).

Dormant seeds of two varieties of barley were exposed to 15 kR x radiation and mutants in the x_2 and x_3 generations were selected for field trials. Mutants through the x_8 generation were analyzed for certain characteristics, mainly earliness and short-stem. Breeding methods at each generation for the selection of short-stem mutants are described. (C.H.)

18419 MUTATION BREEDING IN SOYBEANS AND COMMON BEANS. Gotoh, Kanji (Hokkaido Prefectural Agricultural Experiment Station, Memuro, Japan). Gamma Field Symp., No. 3, 75-89(1964).

Seeds of 3 soybean varieties and 4 common bean varieties were exposed to ^{60}Co γ radiation of 6 to 2 kR. Visible x_2 mutants were selected in the field and their progeny were tested in the next generation. Data are summarized on the breeding program and characteristics of mutants. Results indicate that exposure to γ radiation may induce valuable mutations of beans. (C.H.)

18420 SOME ASPECTS OF RADIOSENSITIVITY OF CROP PLANTS UNDER CHRONIC EXPOSURE. Yamashita, Atsushi (Inst. of Radiation Breeding, Ibaraki-ken, Japan). Gamma Field Symp., No. 3, 91-110(1964).

Problems involved in the use of radioinduced mutations in field crop breeding programs are reviewed. Results are summarized from studies on the radiosensitivity of a number of summer and winter field crops under chronic exposure to γ radiation. It was concluded that the major factors that affect radiosensitivity of a given species are genetic constitution, development stage, temperature, and dose rate. Results are also included from a study of the possible relation between the pattern of gross morphological damage or seed fertility and mutation rate in oats, Avena strigosa (diploid) and Avena sativa (hexaploid), exposed to neutrons and x radiation. (C.H.)

18421 STUDIES ON RADIOSENSITIVITY AND INDUCTION OF SOMATIC MUTATIONS IN FOREST TREES. Ohba, Kihachiro (Inst. of Radiation Breeding, Ibaraki-ken, Japan). Gamma Field Symp., No. 3, 111-41(1964).

Results are reported from studies of the effects of chronic γ exposure on the morphology and induction of somatic mutations in forest trees. Data are presented on the lethal effects of dose rates of 10 to 20 R/day on forest

trees; the effects of γ radiation on tree growth; the effects of acute γ exposure on growth and longevity of forest trees; and a description of somatic mutations induced in forest trees by exposure to γ radiation. The trees studied included several species of pine and oak, Taxus media, Cryptomeria japonica, Chamaecyparis, Alnus, Populus, and Larix leptolepsis. The data show that the radiosensitivity of forest trees varies with the species. Coniferous trees, that have large nuclear volume with small chromosome numbers, were found to be especially radiosensitive. The injurious cumulative effect of chronic exposure was obvious in yearly decrease of lethal dose rate and in yearly increase of damages of saplings grown in the γ field. This cumulative effect appeared to be intensified in winter when the trees were more radiosensitive. Reproductive organs of trees were shown to be most radiosensitive during their initial differentiating stage. Several kinds of somatic mutations were observed in irradiated trees, including chlorophyl, morphological, and waxless changes in coniferous tree species. (C.H.)

Radiation Effects Therapy and Countermeasures

Refer also to abstracts 18259 and 18362.

18422 (ACRH–24) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Jacobson, Leon O. (ed.) (Argonne Cancer Research Hospital, Chicago, Ill.). Sept. 1965. Contract AT(11-1)-69. 195p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Information concerning activities in various biological and medical fields associated with cancer research is presented in nineteen papers. The information in these papers was published previously. An abstract was prepared for one paper. (J.R.D.)

For an abstract of the individual paper see: 18423.

18423 (ACRH–24, pp 125-34) ADVANCES IN SUPERVOLTAGE TREATMENT PLANNING. Lanzl, L. H.; Rosenfeld, L. (Argonne Cancer Research Hospital, Chicago, Ill.). (CONF-650907–3).

Instruments and techniques for use in improved radiation therapy are discussed. Steps that might be taken in planning for rotation therapy of a typical patient are described to illustrate the design and use of these instruments and techniques. (J.R.D.)

18424 (AD–630199) GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES AND RELATED SUBSTANCES, AS SOURCES OF ANTIRADIATION DRUGS. Interim Research Report No. 25, October 1–December 31, 1965. Buckman, J. D.; Barbee, R. B.; Bellas, M.; Engelhardt, P. R.; Giles, P. M.; Hood, B.; Field, L. (Vanderbilt Univ., Nashville, Tenn.). Contract DA-49-193-MD-2030. 28p. CFSTI $2.00 cy, $0.50 mn.

Research was continued on cyclic disulfides and their oxidation products and on uses of the latter for synthesis of antiradiation drugs. The lead mercaptide of 1,4-butanedithiol is converted to 1,2-dithiane in 92% yield by reaction with sulfur, but a similar attempt to cyclize the 1,4-disulfinic acid to the disulfone failed. 1,2-Dithiane has been oxidized to the corresponding disulfone under various conditions to increase the yield as much as possible for this model system. Further study was made of the conversion of the disulfone to sulfolane (tetrahydrothiophene dioxide). Syntheses have been continued of compounds of the type $\underline{n}\text{-}C_{10}H_{21}NH(CH_2)_2SS(CH_2)nX \cdot HCl$. The compound with n = 3, X = NHAc, has been submitted for screening and several compounds with n = 1, X = p-substituted phenyl are nearly ready for submission. Investigation has begun of compounds of the structure $RR'C(OH)S(CH_2)_2NH_3^+Cl^-$. Hopefully, these compounds will serve as blocked thiols which will release the active thiol in vivo. A number of studies have been made of the compound $\underline{p}\text{-}C_7H_7SO_2N = C(SK)_2$. Mono- and dialkylation reactions have been clarified. Oxidation has given an isothiocyanate, although a trace of the hoped-for dithiacyclopropane may have been formed. Reaction of thiolsulfonates with dithio acids proved unpromising for synthesis of structures of the form RC(S)SSR', the products were not obtainable in a very pure state. Disproportionation studies of a number of carbonyl and thiocarbamoyl disulfides were completed and correlations were drawn with structural features. Research has been initiated on the use of sulfonyl sulfides ($RSO_2\text{-}S_x\text{-}SO_2R$) for preparing antiradiation drugs. Synthetic work has been continued directed toward preparation of 2,5-bis-(2-aminoethyldithio)-1,4- benzenedicarboxylic acid, a bis analog of the active drug o-(2-aminoethyldithio) benzoic acid (VU26). Two compounds were submitted for screening of their radioprotective properties. (auth)

18425 (AD–630338) ENDOTOXIN PROTECTION OF MICE. THE RELATIONSHIP TO COLONY-FORMING UNITS. Hanks, G. E.; Ainsworth, E. J. (Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 21, 1965. 40p. (USNRDL-TR-957). CFSTI $2.00 cy, $0.50 mn.

Earlier studies showed that bacterial endotoxins increase survival of irradiated animals. Although these substances do not confer as much protection as do the classical chemical protectants, endotoxins do significantly increase survival when given either before or for a short time following irradiation. The mechanisms of endotoxin protection have not been clearly established, but earlier studies have shown that hematopoietic stimulation is involved. The present studies were designed to evaluate the effects of endotoxin on proliferative cells in the hematopoietic system. Methods have recently been devised to measure the number of certain proliferative cells within the bone marrow, spleen, and other hematopoietic sites. These proliferative cells are called colony-forming units (CFU's), and their numbers are estimated by counting the colonies or nodules in the spleens of irradiated mice which arise either spontaneously or after injection of hematopoietic cells. The present data indicate that endotoxin does not alter the radiosensitivity of endogenous splenic CFU's; the D_{37} for CFU's is about 90 R in both endotoxin-treated and control mice. When endotoxin is injected at the time which produces optimal survival, the femur content of CFU's increases about 2 fold; whereas, the spleen content of CFU's is increased about 20 fold. The increased rate of CFU's migration from the femur to the spleen is endotoxin-treated animals may contribute to the relatively greater increase in splenic CFU's. The diameter of the CFU's in the endotoxin-treated mice is somewhat larger than in controls which may have implications relating to rates of cell division. Other data are presented which relate to the extent to which time of endotoxin injection and numbers of splenic CFU's can be correlated with survival of irradiated mice. (auth)

18426 (N–65-21422) INVESTIGATION OF POTENTIAL ANTI-RADIATION AND ANTI-NEOPLASTIC COMPOUNDS RELATED TO PLANT GROWTH REGULATORS. Quarterly Progress Report No. 2, October 1, 1964–January 1, 1965. Schultz, Robert D.; Norman, David (North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.). Contract PH-43-64-865. 19p. (NASA-CR-62133; SID–65-79-2). CFSTI $1.00 cy, $0.50 mn.

Investigations of cytotoxic effects of plant growth regulators on ascites tumors, in vitro, included: possible interference with an oncogenic virus–host cell interaction; synergism or inhibition by indolyl compounds; cytocidal activity of radiation-protective auxin analogs and related compounds; morphological changes in carcinoma cells; and effects of IABu(t) on the respiration of free Ehrlich ascites cells. Study of cytotoxic effects of plant auxin analogs on ascites tumors, in vivo, included: effect of injection vehicle on tumorcidal activity: acute cytocidal effects against P815 mast cell ascites tumor; and in vivo experimentation. New data have also been derived on the radiation-protective effects of auxin analogs and in two-dimensional chromatography of indolyl compounds that are endogenous to some ascites tumors. (STAR)

18427 (ORNL-3920) STOCHASTIC DIFFERENCE EQUATIONS OCCURRING IN ONE-COMPARTMENT MODELS. Uppuluri, V. R. Rao (Oak Ridge National Lab., Tenn.); Feder, P. I. (Stanford Univ., Calif.); Shenton, L. R. (Georgia Univ., Athens). Apr. 1966. Contract W-7405-eng-26. 34p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Bernard, Uppuluri, and Shenton (ORNL 3809, June 1965) earlier considered a simple model for the distribution of radioactive material in a multicompartment system. In this model, the system initially holds unit mass of radioactive material and then emits this according to a random mode of decay. A one compartment system is considered here in which radioactive materials are injected at unit time intervals to compensate for material that has decayed. Two models for injection and decay were considered. The first model corresponds to unit pulsing and random decay and the second model corresponds to random pulsing and constant decay. (M.O.W.)

18428 (SZS-11(1965)) BIOLOGISCH-CHEMISCHER STRAHLENSCHUTZ (ZUSAMMENFASSENDER BERICHT). (Biological-Chemical Radiation Protection (Summary Report)). Huber, R. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec. 1965. 48p. Dep. mn.

A summary is presented of the present status of chemical radiation protection. The possible direction of future developments is discussed. (168 references.) (C.H.)

18429 PROTECTIVE ROLE OF WATER IN THE MEAL OF IRRADIATED PISUM. Houben, J. (Univ., Liege). Bull. Cl. Sci., Acad. Roy. Belg. (5), 51: 906-15(1965). (In French).

The study of the dielectric losses in Pisum meal at different hydrations reveals the existence of two modes of water absorption. It is admitted that the water effect on the production and the decrease of free radicals is due to a casing effect and to an indirect action. (tr-auth)

18430 CORRELATION OF TWO FORMS OF POST-RADIATION DESTRUCTION OF CELLS IN BONE MARROW OF MICE WITH AND WITHOUT PROTECTION BY MEKSAMINE. Aleksandrov, I. D. (Inst. of Biological Physics, SSSR). Dokl. Akad. Nauk SSSR, 164: 437-40 (Sept. 11, 1965). (In Russian).

An attempt was made to estimate quantitatively the destruction of cells in the interphase and after the division, during the first two cycles following irradiation, and to establish the prophylactic merits of 5-methoxytryptamine. The experiments were carried out on white mice. An assumption that cells with deformed chromosomes perish during mitosis made possible a theoretical calculation of the number of cells destroyed in this stage. The results show that even after a comparatively small dose during the first postradiational cell cycle, the interphase destruction of the bone marrow elements considerably prevails over the postmitotic destruction. It was found that 5-methoxytryptamine gives some protection against the lethal effect which results from the structural changes in the chromosomes and does not give any protection against the action of radiation which causes the destruction of the cells prior to their postradiational division. (TCO)

18431 ON THE COMMON MECHANISM UNDERLYING THE RADIOPROTECTIVE PROPERTIES OF AMINOTHIOLS AND ANOXIA. Graevskii, E. Ya.; Konstantinova, M. M.; Sokolova, O. M.; Tarasenko, A. G. (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 441-4(Sept. 11, 1965). (In Russian).

Experimental verification of the hypothesis that the basic mechanism of radioprotective effects is related to an increased level of free sulfhydryl groups in the tissues was attempted. White mice aged 8 to 12 weeks were irradiated with 900 R ($LD_{100/30}$) and were kept in glass containers to facilitate change of air. The following aminothiols were injected subcutaneously 15 to 30 minutes before irradiation or before sulfhydryl group determination: cysteamine, cystamine, β-mercaptopropylamine, and serotonin. Radioprotection was determined by survival beyond 30 days. It was found that all the agents that have a radioprotective effect caused considerable (10-35%) increase (compared to control levels) of the sulfhydryl groups in spleen homogenate under argon. It is concluded that the predominant mechanism of radioprotection is related to an increase of highly reactive endogenous sulfhydryl groups, due probably to lesser oxidation and spontaneous reduction of the S-S bonds. These appear to be highly mobile groups in low molecular compounds which are inactive products of radiolysis of the biomacromolecules. (TCO)

18432 EFFECT OF INTESTINAL TRACT SHIELDING IN IRRADIATED MICE ON HEMATOPOIESIS RESTORATION. Yanushevskaya, M. I. (Severtsov Inst. of Animal Morphology, Academy of Sciences, SSSR). Dokl. Akad. Nauk SSSR, 164: 445-7(Sept. 11, 1965). (In Russian).

Mitotic indices and chromosome aberrations of irradiated bone marrow were investigated in control and experimental groups of mice (S57BL line). The intestinal tract of the experimental animals was shielded by a 6 mm lead plate during x irradiation with single 700 R doses. Control and experimental animals were killed at periods of ½ hr, 1 hr, 2 hrs, 3 hrs, 5 hrs, 9 days, and 12 days following irradiation to determine mitotic indices and chromosome aberrations. Mitotic indices were based on the number of mitoses for 1000 to 3000 cells. The percentage of chromosome aberrations was based on the number of cells with bridges and acentric fragments for 60 to 100 anaphase-telophase stages. Findings show that intestinal tract shielding increases survival of animals by 36.0 ± 9.6%. Shielding of the intestinal tract accelerated the restoration of hematopoiesis in irradiated bone marrow by earlier normalization of mitotic activity and by faster elimination of cells with chromosome rearrangements, which in turn accelerated the regeneration of hematopoietic tissues. (TCO)

18433 ANTIRADIATION EFFECTIVENESS OF ENDOGENIC SULFHYDRYL COMPOUNDS. Graevskii, E. Ya.; Nekrasova, I. V.; Tarasenko, A. G. (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 684-5(Sept. 21, 1965). (In Russian).

A study was conducted to demonstrate that radioprotective agents do not in themselves exert a radioprotective effect, but rather induce the production of active sulfhydryl compounds that in turn have a radioprotective effect. Splenic homogenates in an Ehrlich ascites solution were injected in mice 15 min prior to x-irradiation (700 R). Homogenates from dead animals noticeably reduced cell injuries, but this protective effect was less significant than that of cystamine and mercamine. Results indicated that free sulfhydryl groups possessing significant radioprotective activity (capable of reducing injury to ascites cells) are found in the spleens of animals under oxygen-free conditions. It is possible that the radiosensitivity of various cells and tissues at various stages of their development may be associated with differences in the levels of these particular types of highly reactive, endogenic, sulfhydryl compounds. (H.G.D.)

18434 EFFECT OF NITRIC OXIDE AND HYDROGEN SULPHIDE ON RADIATION SENSITIVITY OF SPORES OF BACILLUS MEGATERIUM IN SUSPENSION. Russell, C. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Experientia, 22: 80-1(1966).

The effects of NO and H_2S on the radiosensitivity of wet spores of Bacillus megaterium in buffered suspension was investigated. A slight sensitization by NO was observed when NO was present during irradiation at a concentration of 0.5% NO in N_2. However, the sensitivity of B. megaterium spores fell at concentrations above 0.5%, being below that in N_2 when 100% NO was used. Hydrogen sulfide did not sensitize the spores. (H.G.D.)

18435 EFFECTS OF pH ON THE RADIOPROTECTION OF BARLEY SEEDS BY MINERAL SALTS. Gillet, C.; Archambeau, J. (Univ., Liege). Experientia, 22: 82-3 (1966). (In French).

Radioprotection of x-irradiated (4,8, or 12 kR) barley seeds by phosphates and carbonates was minimal at pH 6

to 6.5. Values both above and below these augmented the protective effect, particularly in basic solutions. (H.G.D.)

18436 THE EFFECT OF SPLENECTOMY ON THE RADIATION DISEASE OF IN UTERO IRRADIATED FOETUS. Fridrich, R. (Univ., Basel). Experientia, 22: 116-17(1966).

Modification of fetal radiation damage by splenectomy was studied in mice. Splenectomy within 2 hrs after whole-body x-irradiation with 250 R resulted in no improvement in the fetal survival rate. Fetal death rate was higher in the case of splenectomized and sham-operated mice than for irradiated mice. It is suggested that surgical trauma is responsible for death in the latter group. (H.G.D.)

18437 THE MODIFICATION OF THE EFFECTS OF RADIATION ON MICE BY ADRENAL CORTICAL HORMONES. Irie, Hideo; Katayama, Hitoshi (Kyushu Univ., Japan). Nippon Acta Radiol., 25: 205-12(June 1965). (In Japanese).

A study was made of the modification of therapeutic and lethal effects of radiations in mice by adrenal cortical hormones. When adrenal cortical hormone was used after a single local x-irradiation, the growth inhibiting effect of x-irradiation was increased. On the contrary, hormone administration before x-irradiation increased the growth of Ehrlich subcutaneous tumors in mice. Lethal effects of single whole body doses of x-irradiation were increased by hormone treatment. (TCO)

18438 MEDICAMENTS AGAINST POISONING WITH RADIOACTIVE SUBSTANCES. Catsch, A. (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 8: 56-9 (Jan. 1966). (In German).

Treatment of radioactive poisoning by chelating agents is surveyed. Emphasis is placed on the use of diethylenetriaminepentaacetic acid (DTPA) which may be regarded as the compound of choice so far as lanthanides, yttrium, thorium, uranium, plutonium, and other transuranic elements are involved. Usually, DTPA is administered as calcium-chelate. Its toxic side effects which may arise from prolonged treatment are thought to be due to the chelation of essential trace metals. The zinc-chelate of DTPA has a markedly reduced toxicity whereas its efficacy in removing internally deposited radionuclides is found to be insignificantly diminished as compared with Ca-DTPA. The possible therapeutic use of Zn-DTPA is discussed. Radiocaesium, a potentially hazardous radionuclide, is not influenced by chelating agents. A marked diminution of its body burden, however, can be achieved by oral administration of Prussian Blue. This non-toxic compound binds radiocaesium excreted into the gut and thus abolishes its intestinal reabsorption. (auth)

18439 EFFECT OF COMBINED EXPOSURE TO ACCELERATION, VIBRATION, AND RADIATION ON BONE MARROW CELL NUCLEI IN MICE. Arsen'eva, M. A.; Belyaeva, L. A.; Golovkina, A. V. Probl. Kosm. Biol., 4: 373-90(1965). (In Russian).

The mitotic activity of the bone marrow cells of mice exposed to the individual and combined effects of acceleration, vibration, and radiation was studied. The experimental parameters of the tests and their quantitative results are tabulated. In general, it was felt that the various physiological changes occurring as a result of acceleration or vibration lead to disruptions of mitotic activity that may reflect a unique protective effect from radiation. (TCO)

18440 INJURIOUS EFFECT OF 660- AND 120-Mev PROTONS AND THE EFFICACY OF PHARMACOLOGICAL AND CHEMICAL PROTECTION. Shashkov, V. S.; Morozov, V. S. Probl. Kosm. Biol., 4: 401-10(1965). (In Russian).

Male white mice weighing 18 to 21 g were subjected to 264 rad doses of ^{60}Co γ rays and 500 to 700 rad doses of 120 and 660 Mev protons. The experiments were also designed to test chemical agents during proton irradiation with a known radioprotective effect against x rays and γ rays. The $LD_{50/30}$ for ^{60}Co γ rays was calculated to be 600 rad, and for 660 Mev protons, 900 rad. Thus, the RBE of 660 Mev protons, according to the LD_{100} index, is 0.73. The radioprotective substances tested were effective against high-energy protons. (H.G.D.)

18441 EFFECT OF SCREENING INDIVIDUAL PARTS OF THE BODY OF ANIMALS ON CHANGES IN RADIATION REACTION ON EXPOSURE TO GAMMA RAYS AND HIGH-ENERGY PROTONS. Razgovorov, B. L.; Morozov, V. S.; Shashkov, V. S.; Antipov, V. V.; Dobrov, N. N.; Konnova, N. L.; L'vova, T. S.; Saksonov, P. P. Probl. Kosm. Biol., 4: 411-29(1965). (In Russian).

Experiments were conducted in rats to determine the effect of screening during irradiation of animals with γ rays and 120 Mev protons. Lead-shielded polyethylene blocks were used to screen the proton beams, and γ-irradiated animals were shielded with steel plates. Biological effects of radiation under these conditions were determined by 30-day survival. Localized shielding during gamma irradiation of rats with 930 rad doses increased the survival rate and was most effective during abdominal shielding. Abdominal shielding also moderated the course of radiation sickness and lessened the degree of leukopenia. In a second series of experiments, the abdomens of rats were shielded with Plexiglas blocks of different widths during irradiation with protons and γ rays. It was found that shielding the abdomen with a block 6 cm wide during proton irradiation with 800 to 1050 rad increased the survival rate to 86.4%. A high survival rate (96.7 to 100%) was also observed when the abdomen was shield with blocks of various widths during γ-irradiation (930 rad). Preliminary experiments were also conducted to show the effect of shielding under the combined influence of protons and acceleration or vibration. Results showed that neither 30 min of acceleration (10 g) nor 1 hr of vibration (700 cps, amplitude 0.005 min) altered the effectiveness of screening during proton irradiation. Furthermore, it was found that the effectiveness of abdominal shielding increases with radiation dose. (H.G.D.)

18442 ELIMINATION OF INJURIOUS EFFECTS OF β RADIATION ON SEEDS OF CULTIVATED PLANTS BY MEANS OF PHYSIOLOGICALLY ACTIVE COMPOUNDS. Shaidarov, Yu. I. Probl. Kosm. Biol., 4: 469-73(1965). (In Russian).

The radioprotective effects of N-(2-pyridyl)-N_4-(2'-hydroxy-1',4'-naphthoquinone)-4-ylsulfanilamide (designated P-46); di-(para-trichloroacetylaminophenyl) sulfone; and 2-Retononanoic acid were studied on seeds of corn, lupine, turnip, and spring wheat soaked in phosphorus-32 solutions for 2 or 4 days. Treatment of corn seeds with ^{32}P lowered the weight of the green mass of corn plants. However, application of the chemical preparations not only eliminated the injurious radiation effect, but increased the harvest as compared with the control. Under these conditions lupine was less responsive than corn to the effects of either ionizing radiation or the radioprotectors. Phosphorus-32 exerted a clearly negative influence on spring wheat seeds, and the preparations had the opposite effect. Most effective in this case was P-46. To study the aftereffects of treatment with radioactive phosphorus and P-46, seeds obtained from treated wheat plants were sown the following year. It was found that the harmful effects of ionizing radiation are retained in the second generation. However, preparation P-46 completely removed the injurious radiation effect in that generation. Data indicate the possibility of partially or completely removing the depressing effect of β-radiation on plants with the help of physiologically active compounds. (H.G.D.)

18443 MODELING OF RADIATION CONDITIONS ON A CIRCUMLUNAR TRAJECTORY DURING A SOLAR FLARE. Morozov, V. S.; Shashkov, V. S.; Davydov, B. I.; Antipov, V. V.; Saksonov, P. P.; Dobrov, N. N. Probl. Kosm. Biol., 4: 701-8(1965). (In Russian).

Biological effects of cosmic radiation were studied in a simulated lunar flight including a short solar flare. White mice were fed a special concentrate and exposed to γ radiation (900 to 920 R). Controls were given acute 900 to 920 R γ doses. Trajectory doses were 60 to 80 R. Prior to the simulated solar flare, the animals were given

cystamine, AET, or 5-methoxytryptamine. Results showed that the pharmacological protection was slight, being greatest when AET was administered during flight and flare portions of the test. Lower mortality among animals in the flight group was attributed to acceleration and exposure to low doses of radiation before acute exposure. (H.G.D.)

18444 THE ROLE OF POST-IRRADIATION REPAIR PROCESSES IN CHEMICAL PROTECTION AND SENSITIZATION. **Alexander, P.; Lett, J. T.; Dean, C. J. (Royal Cancer Hospital, London). Progr. Biochem. Pharmacol., 1: 22-40(1965).**

Evidence is presented which indicates that dose-modifying treatments may act by altering the capacity of cells to repair by metabolic process the radiochemical damage produced by ionizing radiation. It is postulated that the critical structure (probably DNA), damage to which initiates cell death (defined as loss of ability to divide indefinitely), is capable of repair, but that this process is itself radiosensitive. The dose needed to kill cells is therefore determined by the inherent sensitivity of the critical structure and of the repair process. The radiosensitivity of the critical structure (viz. DNA) is less easily modified than that of the repair process. Physico-chemical mechanism by which -SH compounds, like cysteamine and -SH poisons like iodoacetamide, alter the extent of radiation damage to the repair processes are discussed. Other treatments (e.g., bromouracil incorporation) sensitize by directly blocking repair processes. The implications of this hypothesis for the application of sensitizers in radiotherapy are discussed. The mechanism of the protectors in vivo is complex because cysteamine and related compounds produce a biochemical shock which profoundly alters the physiological state of cells. Protection is the result of this biochemical shock. (29 references) (auth)

18445 THE SENSITIZATION OF LYMPHOMA CELLS TO X-RAYS BY 5-BROMODEOXYURIDINE: THE ROLE OF POST-IRRADIATION RECOVERY PROCESSES. **Lett, J. T.; Alexander, P. (Royal Cancer Hospital, London). Progr. Biochem. Pharmacol., 1: 41-5(1965).**

Murine lymphoma cells, which provide a number of mutants that vary in radiosensitivity but are similar in other respects, were used to study the effects of 5-bromouracil incorporation in DNA on the x radiosensitivity of the cells. Results showed that when the same amount of 5-bromouracil was incorporated into both strands of DNA of these mutants they were sensitized to a different extent but once a critical 5-bromouracil incorporation was attained the different mutants exhibited the same radiosensitivities. It is postulated that the initial sensitization is the result of the inhibition of a repair system (probably enzymic) and that when this is completely inhibited further sensitization proceeds in the same manner as in untreated DNA. (C.H.)

18446 THE SENSITIZATION OF BACTERIA TO X-RAYS BY IODOACETAMIDE AND SOME RELATED COMPOUNDS. **Dean, C. J.; Alexander, P. (Royal Cancer Hospital, London). Progr. Biochem. Pharmacol., 1: 46-51(1965).**

Iodoacetamide is a powerful SH poison that possesses a halogen atom and a highly polarized carbonyl group. The importance of the chemical structure on the radiosensitizing effects of this compound was investigated in x irradiated bacteria. Micrococcus sodonensis and micrococcus radiodurans, which exhibits extreme radioresistance, were dramatically sensitized to x radiation by iodoacetamide. The degree of sensitization was dependent on the concentration of iodoacetamide. The same enhanced radiosensitivity was also found for Pediococcus cereviseae, Staph. aureus, E. coli, and CB1, a gram positive coccus. The effects of 6 SH-poisons, including iodoacetamide, iodosobenzoic acid, p-chloromercuribenzoate, divinylsulfone, N-ethylmaleimide, and ethyl methane sulfonate and the effects of 3 halogen compounds that do not normally react with SH groups, including potassium iodide, chloral hydrate, and trifluoroacetoldehyde hydrate on the radiosensitivity of M. sodonensis were evaluated. The halogen containing SH poisons, iodoacetamide, iodobenzoic acid, and p-chloromercuribenzoate gave the best enhancement of radiation inactivation, with the best results obtained with iodoacetamide. It was concluded that the presence of a halogen or the polarized carbonyl group and the ability to react with SH groups does not necessarily confer on a compound the ability to sensitize M. sodonensis, but the presence of 2 of these properties does increase the ability to sensitize resistant bacteria to x radiation. (C.H.)

18447 EFFECT OF LOW TEMPERATURE ON RADIOSENSITIVITY OF ARTEMIA OOCYTES. **Cervini, A.; Giavelli, S. (Univ., Milan). Progr. Biochem. Pharmacol., 1: 52-8(1965).**

Results are reported from an analysis of the effects of low-temperature pre- and post-treatments on the sensitivity of prophase oocytes of a parthenogenic strain of shrimp, Artemia salina, to x radiation. The irradiation was done on groups of Artemia in artificial sea water at temperatures of 22°C or a 30-min pre-treatment or post-treatment at 0°C. The x radiation dose used was 500 R. The criterion of radioinduced damage was the inhibition of hatchability of the oocytes. Results showed that low-temperature decreased the effects of x radiation on the oocytes and its action was more evident in pre-treatment than in post-treatment. (23 references.) (C.H.)

18448 CYSTEINE AND THE RADIOSENSITIVITY OF BACTERIA. **Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng.). Progr. Biochem. Pharmacol., 1: 59-64(1965).**

The use of bacteria in studies of the mechanism of the radioprotective action of cysteine at the cellular level is discussed. It is pointed out that cysteine is spontaneously oxidized by atmospheric oxygen and in many circumstances this results in a greatly reduced oxygen tension and correspondingly reduced radiosensitivity effect. Results of studies on the effects of a 0.1M solution of cysteine on the sensitivity of Serratia marcescens to x radiation when exposed in 100% oxygen, intermediate oxygen conditions, or anaerobic conditions are discussed in relation to various theories concerning the mechanism of action of cysteine. The intracellular SH content of the cells was used as the criteria of radiation effects. (11 references.) (C.H.)

18449 A POSSIBLE MECHANISM FOR CHEMICAL PROTECTION AGAINST RADIATION DAMAGE. **Lohmann, W. (Univ. of Arkansas, Little Rock. Veterans Administration Southern Research Support Center, Little Rock, Ark.). Progr. Biochem. Pharmacol., 1: 118-36(1965).**

Mechanisms for the radioprotective action of certain chemical compounds, based on reactions of radioprotective substances with either free radicals produced by radiation in aqueous solutions or metal ions in macromolecules forming a metal-water-substance complex, are discussed. The radiation effect is usually divided into two groups, with the indirect effect produced by free radicals generated by radiation in aqueous solutions. The best radioprotective compounds are expected to be those that form a complex with the active site of the macromolecules, or chelating substances. The protection afforded to catalase by the addition of glycerol prior to irradiation is discussed. The addition of Cu, Mn, or Fe to the aqueous solution provided a radioprotective effect by interacting with the radiation produced free radicals. Sugars and diglycyl−glycine were also found to protect catalase against the effects of radiation. Diglycyl−glycine acts as a radical scavenging protein. Excellent protective effects were also obtained when dimethyl sulfoxide or Se ions were added to catalase solutions prior to irradiation. EPR measurements revealed that these substances also act as complexing agents. A model for describing the physical-chemical aspects of the complex formed, based on sulfur-containing substances acting as complexing agents, is outlined. (C.H.)

18450 METAL BINDING AS A MECHANISM OF RADIOPROTECTION BY THE MERCAPTAN BASES. **Foye, W. O.; Mickles, J. (Massachusetts Coll. of Pharmacy, Boston). Progr. Biochem. Pharmacol., 1: 152-60(1965).**

The possibility of complex formation within animal cells

of metalloenzymes by MEA and MEG was investigated by administration of preformed metal complexes of MEA and MEG to mice prior to x irradiation. In accordance with predicted behavior, the zinc complexes afforded radiation protection, whereas the copper and iron complexes were essentially inactive. Oil/water partition coefficients indicated that no essential differences in the distribution of the complexes in vivo may be expected. Spectrophotometric measurements indicated complexation by metal-binding radioprotective agents of the enzymes catalase and lactic dehydrogenase. (auth)

18451 PROTECTION OF LACTATEDEHYDROGENASE BY D-LACTATE. Dose, K. (Max-Planck Inst. of Biophysics, Frankfurt am Main). Progr. Biochem. Pharmacol., 1: 161-6(1965).

No protection against the effects of uv and x radiation was afforded lactatedehydrogenase by D-lactate. Results of this study indicate that two different mechanisms are involved in the radioinduced alteration of enzyme activity. (C.H.)

18452 RADIOPROTECTIVE EFFECTS OF MYCELIUM DERIVED OLIGOPOLYNUCLEOTIDES. Barnard, R. D.; Freeman, M. D. (Lindsay Labs., Brooklyn). Progr. Biochem. Pharmacol., 1: 167-72(1965).

Oligopolynucleotides derived from either aspergillis or streptomyces mycelia were effective in preventing systemic toxicity induced by the administration of nitrogen mustard for the treatment of transplanted tumors in mice. (C.H.)

18453 SOME BIOCHEMICAL EFFECTS OF S-CONTAINING PROTECTIVE AGENTS AND THE DEVELOPMENT OF SUITABLE SH/SS SYSTEMS FOR THE IN VITRO STUDIES OF SUCH EFFECTS. Eldjarn, L. (Univ., Oslo). Progr. Biochem. Pharmacol., 1: 173-85(1965).

A review of our present knowledge on the biochemical and cellular effects of thiols and disulfides reveals that the lack of stability of the SH/SS test system limits the reliability of most of the results. It is believed that the systems described above for the buffering of thioldisulfide mixtures and for the prevention of thiol autoxidation will contribute effectively to the further study of the SH/SS effects. So far these systems have been successfully applied for the determination of the Michaelis-Menten constant of glutathione reductase, and for the investigation of the SH/SS effects on erythrocytes and on mitochondria. The SH/SS toxicity on tissue culture cells (Chang human liver cell) was studied, and marked differences were found in the effects of cysteamine and cystamine. Apparently a reinvestigation of most of the problems concerning SH/SS effects on biochemical function may prove rewarding. (44 references.) (auth)

18454 A FEW ASPECTS OF EARLY RADIATION PATHOLOGY AS GUIDE TO CHEMICAL PROTECTION AND SENSITIZATION. Brinkman, R.; Lamberts, H. B.; Veninga, T. S. (Univ., Groningen, Netherlands). Progr. Biochem. Pharmacol., 1: 203-8(1965).

The protective effects of amines, released by the radioinduced rupture of cell membranes, against radiation injuries is postulated. Data are included from studies on the chemoprotection of mice against 1,250 R x radiation by a bioamine mixture, the effects of anoxia on the release of amines from tissues, the effects of ozone of various concentrations on the x ray sensitivity of mice, and the effects of skin cooling on radiosensitivity of skin, and the effects of temperatures ranging from 10 to 40°C on the stability of the membranes of human erythrocytes exposed in vitro to 5,000 R x radiation. (C.H.)

18455 THE EFFECTS OF X-IRRADIATION ON THE NUCLEAR STRUCTURE OF RAT THYMOCYTES. Whitfield, J. F.; Brohee, H.; Youdale, T. (C.C.R., Euratom, Ispra, Italy). Progr. Biochem. Pharmacol., 1: 209-25 (1965).

X irradiation causes rat thymocyte nuclei to lose their normal interphase reticular-granular structure. This loss of structure is accompanied by severe changes in the properties and localization of DNA associated histones; they leak into the cytoplasm and those that remain in the nucleus become extractable by short exposures to hot trichloroacetic acid. These nuclear changes are retarded by raising the sodium concentration of the medium and the exposure to spermidine after irradiation. They are accelerated by increasing the phosphate concentration of the medium. High concentrations of sodium and spermidine could not, however, prevent the radiation-stimulated production of lactate; this was due to the fact that these agents themselves stimulated lactate production in unirradiated suspensions. All symptoms of radiation damage (cytological changes, acquisition by unfixed cells of erythrosin B stainability, lactate production) are prevented by post-irradiation exposure of the cells to nicotinamide. (auth)

18456 CARDIOVASCULAR DAMAGE BY X-IRRADIATION AND THE POSSIBLE CHEMOPROTECTION AGAINST THIS. Lamberts, H. B. (Univ., Groningen, Netherlands). Progr. Biochem. Pharmacol., 1: 235-41(1965).

Experimental and therapeutical x irradiation caused appreciable damage to arteries and to the heart of rabbits, leading to severe occlusion of the vessels, to myocardial fibrosis, and even heart infarction. A reasonable protection was obtained by injecting sodium thiosulfate prior to irradiation. Preliminary experiments with Cyclohexanol succinate (Radioplex) indicated it had no effect on radioinduced arterial damage in rabbits. (auth)

18457 RADIOPROTECTION AND MITOSIS: AN INVESTIGATION ON REGENERATING RAT LIVER. Laddaga, M.; Leonori, P. (Univ., Pisa, Italy). Progr. Biochem. Pharmacol., 1: 242-8(1965).

Cysteamine administered intraperitoneally (100 mg/kg b w) to rats before localized x irradiation of the liver caused reduction of the mitotic inhibition observed with a 2,000 R dose in the course of regeneration induced by partial hepatectomy 5 days after irradiation. No significant differences were noted in abnormal mitosis production in irradiated and protected animals. The protective effect disappeared when cysteamine was administered after irradiation or before hepatectomy. The observed effect seems to consist in a quicker recovery of the induced lesion in the hepatic cell. (auth)

18458 PROTECTIVE ACTION OF AET (BETA-2-ISOTHIURONIUM BROMIDE) IN DISTURBANCES OF SODIUM—AND WATER METABOLISM IN THE SO-CALLED "GASTROINTESTINAL SYNDROME". Zseboek, Z.; Petranyi, Gy. Jr. (Univ., Budapest). Progr. Biochem. Pharmacol., 1: 257-61(1965).

AET provided a marked protective effect when administered to rats, prior to 1,250 R whole-body x radiation. The influence of disturbances of the sodium and water balance, as they emerge in the so-called intestinal death was followed. This effect manifests itself in acting against damages of the sodium resorption of the depletion of the extracellular sodium reserve and of the narrowing of the extracellular water-pool. This sodium and water balance becomes nearly normal on the fifth or sixth post-irradiation day under AET protection, and also it is subject to less change around the third day at the peak of the reaction. (auth)

18459 RADIOBIOLOGICAL EFFECT OF SOME DRUGS STIMULATING OR DEPRESSING THE CENTRAL ACTIVITY WHEN ADMINISTERED IN THE MOUSE BEFORE PANIR-RADIATION. Stuart, C.; Cittadini, G.; Tomiselli, G. (Siena Univ., Italy). Progr. Biochem. Pharmacol., 1: 269-76(1965).

Morphine exercises a protective action if administered to the mouse before total-body x irradiation (LD 100). Nembutal has no significant effect at the doses of 35 μg/g and 60 μg/g with LD 50; in doses of 25 μg/g it has a weak sensitizing action with the LD 50 which becomes statistically significant with LD 100. Cardiazol does not have any effect with LD 50 and with LD 100. Remeflin shows a modest protective action with LD 50 and, on the contrary, a defined sensitizing action with LD 100. (auth)

18460 THE RECOVERY EFFECT INDUCED BY SOME SUBCELLULAR FRACTIONS AGAINST IONIZING RADIA-

TION DAMAGE. Benassi, E.; Piccotti, F. (Univ., Turin). Progr. Biochem. Pharmacol., 1: 306-15(1965).

The growth of transplanted Ehrlich ascite tumor cells was considered both in normal and in total-body x irradiated mice. The numerical increase is slowed down in irradiated animals. The tumor cells irradiated in vivo before the transplantation, showed a numerical increment higher in unirradiated than in total-body irradiated mice, and after a latency period of 6 days an increase higher than that of non-irradiated tumor cells. The accelerated cellular increase could be interpreted as the effect of selection of clones with a shorter vital cycle. The DNA content of tumor cells and the recovery effect on growth curves induced by spleen and medullary tissue homogenates and supernant were investigated. This effect can be interpreted with the hypothesis of an action of DNA. This problem was attacked by studying the incorporation of tritiated thymidine into tumor cells. (auth)

18461 CYTOPATHOGENIC AND RADIOSENSITIZING EFFECTS OF MERACTINOMYCIN IN HUMAN TUMOR EXPLANTS IN TISSUE CULTURE. Klvana, M. (Safarik Univ., Kosice, Czechoslovakia). Progr. Biochem. Pharmacol., 1: 316-19(1965).

Meractinomycin actinomycin D exhibited a radiosensitizing effect in tumor explants from human bronchial carcinomas and human embryonal lung tissue. The degree of increase was dependent upon the time-lapse between the addition of the drug and irradiation. (auth)

18462 REACTIONS OF CULTURED MAMMALIAN CELLS OF VARYING RADIOSENSITIVITY WITH THE RADIOMIMETIC ALKYLATING AGENT, MUSTARD GAS. Crathorn, A. R.; Roberts, J. J. (Royal Cancer Hospital, London). Progr. Biochem. Pharmacol., 1: 320-6(1965).

The mechanism by which alkylating agents of the mustard gas type simulate radiation in their ability to inhibit cell division was investigated. When exponentially growing suspension cultures of mouse lymphoma cells were treated with mustard gas a variety of effects were produced, depending on the amount of mustard used. Higher doses (0.3 to 0.5 μg/ml) resulted in disintegration of many cells but after a number of days the surviving cells reached visible concentrations. Cultures of both sensitive and resistant lymphoma cells were treated with varying amounts of ^{35}S-mustard gas and ^{3}H-thymidine and ^{3}H-uridine were used as tracers to study the effects of mustard gas treatment on DNA and RNA. DNA, RNA, and protein were isolated from mass cultures of resistant and sensitive lymphoma cells with and without treatment with cysteamine before or after the addition of ^{35}S-mustard gas. The cysteamine did not affect the level of binding of mustard gas to RNA and protein, whereas alkylation of the DNA was increased considerably by prior administration of cysteamine to both sensitive and resistant cells. The significance of the results are discussed. (C.H.)

18463 INVESTIGATIONS ON THE EFFECT OF SODIUM CYCLOHEXANOLSUCCINATE ON THE HAMSTER MELANOMA A Mel 3. Ott, F.; Storck, H. (Univ., Zurich). Progr. Biochem. Pharmacol., 1: 327-30(1965).

The effects of the radiosensitizing drug Radioplex (sodium cyclohexanolsuccinate) on hamster melanomas was investigated. This compound had no effect on the sensitivity of melanomas to x radiation. The compound caused an obvious stimulation of tumor growth in old hosts. (C.H.)

18464 A REVIEW OF CLINICAL AND LABORATORY STUDIES OF RADIOSENSITIZERS IN RADIOTHERAPY. Mitchell, J. S. (Univ. of Cambridge, Eng. Addenbrook's Hospital, Cambridge, Eng.). Progr. Biochem. Pharmacol., 1: 335-51(1965).

The use of drugs to improve the treatment of patients with malignant tumors by means of ionizing radiations is discussed with emphasis on recent developments and clinical applications. After a short discussion of radiosensitization and combined tumor-inhibiting action, the most important radiosensitizers are considered. Special attention is paid to oxygen, thymidine analogues, 5-fluorouracil, actinomycin D, immunological methods and Synkavite and related compounds. Information is given about a new clinical trial including the combined use of intravenous Synkavite and oxygen inhaled at atmospheric pressure as radiosensitizers. Recent work on the development of tritiated derivatives of Synkavite of high specific activity for use as a radioactive drug is summarized. (91 references.) (C.H.)

18465 QUINOXALINE-Di N-OXIDE, RADIOPROTECTOR AND RADIOSENSITIZER. Haley, T. J.; Trumbull, W. E.; Cannon, J. A. (Univ. of California, Los Angeles). Progr. Biochem. Pharmacol., 1: 359-65(1965).

Quinoxaline-di-N-oxide decreased radiation mortality in mice receiving 550 R (LD_{100}/30 days) whole-body x irradiation by 50% when administered for three days prior to irradiation. The compound does not prevent radiation induced leukopenia but does prevent the usually fatal post-irradiation enteric organism bacteremia. It has been shown also that quinoxaline-di-N-oxide acts as a radical trap, thus reducing the intra- and extracellular damage from the oxidizing radicals produced by whole-body x irradiation. However, when this drug was administered orally to dogs for two days prior to giving 500 R (LD_{100}/30 days) no radioprotection was observed, in fact the drug sensitized the animals to the lethal effects of irradiation. The sensitization mechanism involved stimulation of the bone marrow with the production of a marked leukocytosis in which the total circulating leukocytes were increased by a factor of three over the predrug value. It is possible that this phenomenon may be species specific for the dog. On the other hand, it is also possible that this effect is not species specific and if so, quinoxaline-di-N-oxide could prove to be a valuable drug for the treatment of drug or irradiation-induced bone marrow depression. (auth)

18466 RESEARCHES ON THE MECHANISM OF ACTION OF THE SKIN-PHOTOSENSITIZING FUROCOUMARINS. Musajo, L.; Rodighiero, G. (Univ., Padua). Progr. Biochem. Pharmacol., 1: 366-71(1965).

The photosensitizing properties exerted by furocoumarins on human and guinea pig skin are reviewed. Results are reported from studies on the mechanisms of the photosensitizing action of furocoumarins on diverse biological systems. On the basis of their effects, furocoumarins are classified into three groups. Data are included from studies of the solubility of some furocoumarins in water and in DNA and RNA solutions. (C.H.)

18467 THE EFFECT OF COLCEMIDE ON THE RADIOSENSITIVITY OF MICE. Rothe, W. E.; Grenan, Marie M.; Wilson, Shirley M. (Walter Reed Army Inst. of Research, Washington, D. C.). Progr. Biochem. Pharmacol., 1: 372-6(1965).

In mice exposed to an LD 100/30 d, either the colchicine derivative, colcemide (50 mg/kg), or urethan (1 g/kg) increased sensitivity to x radiation when administered 12 hr before irradiation. This time-effect coincides with the time of maximum drug damage to the intestine. In contrast, when administered 48 hr preirradiation they protected both normal mice and mice made severely hypoxic by breathing 5% oxygen. However, since bone marrow cell damage reaches a peak at 48 hr after the administration of either drug, intracellular oxygen tension may be critical. It is probable that the toxic effect of these compounds alters the radiosensitivity of mice. Radiosensitization results from drug damage to the intestine. Radioresistance follows metabolic suppression of hemopoietic tissues. (auth)

18468 ON THE MECHANISM OF RADIO-SENSITIZATION BY IODOACETIC ACID AND RELATED SUBSTANCES. Bianchi, M. R.; Boccacci, M.; Quintiliani, M.; Strom, E. (Istituto Superiore di Sanita, Rome). Progr. Biochem. Pharmacol., 1: 384-91(1965).

A number of compounds, more or less related to iodoacetic acid (IAA), were tested for their radiosensitizing effect on rabbit erythrocytes in vitro. Red cells irradiated in vitro with x rays lose their intracellular potassium and show hemolysis in relation to the radiation dose. The

sensitivity to radiation of red cells treated with IAA increased up to 4 times that the untreated cells for both the responses. Bromoacetic acid, iodoacetaminde, iodopropionic acid, N-ethylmaleimide, ethylmethanesulfonate, alcaline iodide, molecular iodine, and chloroform all exhibited a radiosensitizing ability. All compounds, except N-ethylmaleimide, show, in all cases, the same characteristics of the IAA effect, i.e., the sensitization occurs if the substance is present in the system at the moment of irradiation. The sensitizing effect appears to be independent from the alkylating ability of tested compounds, as well as from the inhibition of the glycolysis or from the decrease of ATP level in red cells. The sensitizing effect is inhibited by hemoglobin, human serum albumin, and some amino acids. (auth)

18469 PHOTOSENSITIZATION OF MAMMALIAN CELLS AND OF ANIMAL VIRUSES BY FUROCOUMARINS. Colombo, G.; Levis, A. G.; Torlone, V. (Univ., Perugia, Italy. Univ., Padua). Progr. Biochem. Pharmacol., 1: 392-9(1965).

Evidence is presented that supports the view that the photodynamic effect of furocoumarins on rather simple cytological materials, like mammalian cells in vitro and animals viruses, occurs through photosensitization of nucleic acids, perhaps of DNA. (auth)

18470 ACTION OF RADIOSENSITIZING (CYCLOHEXANOL SUCCINATE) AND RADIOPROTECTIVE DRUGS (BASIC PROTEINS) ON THE RABBIT'S BONE MARROW. Rocca, A.; Iero, C.; Mastroeni, P. (Catholic Medical School, Rome). Progr. Biochem. Pharmacol., 1: 400-5 (1965).

Rabbits were given 100 mg/kg or 600 mg/kg cyclohexanol succinate per day. One group received 10 mg/kg of lysozyme chloride intravenously twice a day for 7 days before the 600 mg/kg daily treatment with cyclohexanol succinate. The peripheral leukocyte and serum lysozyme content were determined periodically and the animals were killed on the 14th day. Histologic examination of bone marrow preparations showed that the pre-treatment of the animals with lysozyme chloride greatly reduced the toxic effects of 600 mg/kg day doses of cyclohexanol succinate. The mechanism of this protective action on the bone marrow appeared to be a preventive one. Possible applications in the use of cyclohexane succinate to increase the radiosensitivity of tumors are discussed. (C.H.)

18471 MECHANISM OF CHEMICAL PROTECTION IN INTACT ANIMALS. Van Bekkum, D. W. (TNO, Rijswijk, Netherlands). Progr. Biochem. Pharmacol., 1: 406-17 (1965).

The techniques employed to estimate the protective action of chemical substances, including so-called screening procedures, and the requirements with regard to quality and standardization of animals as well as with regard to radiation exposure conditions, are evaluated. Among the many different chemical compounds which have been found to possess radioprotective activity only a limited number can be considered to provide an important degree of protection. Various methods are discussed to express quantitatively the protection properties of a drug. On the basis of knowledge of the mechanism of action and of other properties, certain speculations with regard to the clinical applicability of chemoprotective drugs are made. (29 references.) (auth)

18472 ON THE INFLUENCE OF EXTERNAL FACTORS UPON THE EFFICACY OF RADIOPROTECTIVE SUBSTANCES. Langendorff, H.; Langendorff, M.; Melching, H. J. (Univ., Freiburg i. B.). Progr. Biochem. Pharmacol., 1: 418-26(1965).

Results are reviewed from recent experiments with chemical radioprotective compounds that show that their effect on the organism is closely related to several biological and physical factors. These include the type, strain, age, sex, physiological condition, and number of experimental animals; environmental conditions; the purity of the radioprotective compound; the dose; pH value; time of preparation and application of the compound, method of administration; and irradiation conditions such as source and quality of the radiation, dose, timing, and dose distribution in the animals. Variations induced by some of these factors in the response of irradiated experimental animals to AET, serotonin, cysteine, cysteamine, 5-methoxytryptamine, histamine, MEG, AMP, ATR, pyridoxal-5-phosphate, and oxygen, or various combinations of the compounds, are reported. It is suggested that standardized tests be formulated for testing the efficiency of radioprotective compounds. (C.H.)

18473 THE RADIOPROTECTIVE ACTION OF DIFFERENT RADIOPROTECTORS FOR DOSES BELOW 100 r. Koch., R. (Univ., Freiburg, i. B.). Progr. Biochem. Pharmacol., 1: 427-31(1965).

The protective effects of various chemical compounds have been studied almost exclusively in the range of lethal radiation doses expected in the event of an atomic disaster. It is pointed out that most instances of accidental or professional exposure occur in the dose range between zero and 100 R. The effectiveness of several radioprotective compounds against injury from low dose range radiation were compared in mice exposed to 30, 50, or 75 R x radiation. The uptake of ^{59}Fe by young erythrocytes during the 8 days following whole-body exposure was used as the criteria of radiation injury. Results indicate that substances like cysteamine and histamine give more protection against low radiation doses than serotonin, 5-AMP, or pyridoxal-5-phosphate. (C.H.)

18474 RADIOPROTECTIVE AGENTS DERIVED FROM THIOGLYCOLLIC ACID. Rose, F. L.; Walpole, A. L. Progr. Biochem. Pharmacol., 1: 432-41(1965).

Thioglycollic hydrazide contains a structure common to several of the most effective chemical radioprotective compounds. Thioglycollic hydrazide is too unstable to be handled conveniently. Some closely related stable derivatives of thioglycollic hydrazide were prepared and tested in mice for toxicity, protective effects against nitrogen mustard in mice and monkeys, and protective effects against whole-body x radiation in mice. Results showed that N^1: N^4-diacetyldithioglycollic dihydrazide, given intravenously or intraperitoneally, affords considerable protection against the lethal action of nitrogen mustard in mice and monkeys. N-acetylthioglycollic hydrazide and N^1,N^4-diacetyldithioglycollic dihydrazide afforded some protection against the lethal effects of x radiation in mice. (C.H.)

18475 STUDIES ON SELECTIVE EFFECTS OF RADIOPROTECTORS. Garattini, S.; Palma, V.; Reyers, J. (Istituto di Ricerche Farmacologiche "Mario Negri", Milan). Progr. Biochem. Pharmacol., 1: 442-6(1965).

A method to determine a selective protection of the damage induced by radiomimetic drugs in tumor bearing mice is described. Not one of the tested radioprotective agents (cysteine, cysteamine, 5HT, AET) was able to protect normal tissues by the effect of dl-sarcolysine or cyclophosphamide without affecting in the same direction tumor growth (sarcoma 180 or Ehrlich carcinoma. (auth)

18476 RADIOBIOLOGICAL STUDIES WITH FAST NEUTRONS ON THE EFFECTIVENESS OF RADIOPROTECTIVE SUBSTANCES, WITH SPECIAL REGARD TO OPHTHALMOLOGICAL CHANGES. Straub, W.; Graul, E. H.; Ruether, W.; Hundeshagen, H.; Neubauer, H.; Jacobi, K. W.; Krueger, H. (Univ., Marburg, Ger.). Progr. Biochem. Pharmacol., 1: 447-60(1965).

Several thio-derivatives, serotonin, and a serotonin antagonist were tested as radioprotective substances against injuries to the eyes of rabbits. The following compounds proved to be especially active: cysteamine, AET, serotonin, and vitamin B_6. The combined use of protective agent with different points of action greatly increases the final radioprotective effect. This combination was very active against ^{60}Co γ irradiation, but was effective only over a limited dose range when tissues are irradiated with 15-Mev neutrons. This brings up new questions in interpreting the mechanism of neutron action in comparison with x and gamma rays. (auth)

18477 INVESTIGATIONS ON THE NEW POSSIBILITIES OF RADIOPROTECTION. Danysz, A. Progr. Biochem. Pharmacol., 1: 461-6(1965).

Metandrostandiol (Dianabol: CIBA), administered by gastric intubation to mice and rats 7 days before and 12 to 14 days after x irradiation at LD_{100} doses decreased postirradiation leukopenia, prevented the fall of body weight, reduced histopathological changes in internal organs, prevented the decrease in liver DNA content, and prevented the decrease of water content in the blood. A study of the metabolic effects of this androgen showed that, when given repeatedly, it significantly diminishes the consumption of oxygen and the excretion of CO_2. Some correlation was found between the decrease in oxygen consumption and the radioprotective effect. (C.H.)

18478 RADIATION-PROTECTION CAPACITY OF SOME PROCAIENAMIDES AND THEIR NITRATED PRECURSORS. Arnaud, G.; Frossard, H.; Gabriel, J.-P.; Bichon, A.; Saucier, J.-M.; Bourdais, J.; Guillerm, A. (Radiobiological Lab. of the Atomic Study Group of the French Navy, Cherbourg. Faculty of Medicine, Paris). Progr. Biochem. Pharmacol., 1: 467-71(1965).

A radioprotective action has been demonstrated for procaine and some authors assign a similar action to the nitrate functions. Nitrated derivatives of procainamide were prepared and tested in x irradiated mice. The comparative study of the nitrated derivatives, implies the following characteristics for a radioprotective compound: the presence of the morpholine cycle at quaternair nitrogen; presence of a $(CH_2)_3$ chain (like the one found in the active phenothiazines); and the presence of the (R') chain on the first nitrogen, equal to $C_6H_5-CH_2-$. (auth)

18479 PHYSIOCHEMICAL AND BIOLOGICAL INVESTIGATIONS ON THE ACTIVITY OF SOME PROPHYLACTIC RADIOPROTECTORS. Nicolau, Cl.; Grigorescu, S.; Nedelcu, C. (Ministry of Health, Bucharest). Progr. Biochem. Pharmacol., 1: 472-8(1965).

Electron spin resonance measurements led to the establishment of the rate constant featuring the reaction between AET and a stable free radical, in model systems. Such measurements led also to the identification of the free radical radioinduced by a dose of 5.10^6 R of x rays in ACTH. Biological measurements showed a temporarily marked inhibiting effect of a series of radioprotective drugs (cysteine, cysteamine, AET, and adrenaline) on the incorporation of ^{32}P and ^{35}S in bone. Attempts were made to correlate these results, and to explain the facts observed. (auth)

18480 THE INFLUENCE OF CORTISONE ON THE RADIATION EFFECT OF BONES. Zuppinger, A. (Univ., Bern). Progr. Biochem. Pharmacol., 1: 479-88(1965).

Clinical observations seemed to show that radiation effects were diminished when cortisone medication was applied before x ray treatment. Experiments on bones regarding the uptake of ^{45}Ca showed that irradiation after ten days of cortisone medication was followed by a strong reduction of the Ca uptake and a strong reduction of the radiation effect. These effects are only temporary ones. Cortisone application after irradiation showed only a slight reduction of Ca uptake and no diminution of the radiation effect. There is strong evidence that radiation neutralizes temporarily the cortisone effect in osteoblasts. In rats there are sex-linked differences in the uptake of Ca and of the radiation effect. Some possible clinical aspects and deductions of these findings are discussed. (auth)

18481 THIOL COMPOUNDS AS PROTECTORS AGAINST ROENTGEN RAYS AND RADIOMIMETIC AGENTS. Bonati, F.; Savino, G. (Bracco Ind. Chim., Milan. Municipal Hospital, Novara, Italy). Progr. Biochem. Pharmacol., 1: 489-500(1965).

The protective action of a number of thiol compounds against the effects of x radiation and radiomimetic substances were studied in aerobic and anaerobic bacteria. Data are reported on the effects of the radiomimetic compounds, chlormetine and tretamine, on the bacteria, the effects of thiol compounds on these effects, the effects of radiomimetic compounds and thiols on cellular respiration, and a brief comparison of the protective effects of thiol compounds against the effect of x radiation and chlormetine in mammals and bacteria. (C.H.)

18482 IN VIVO AND TISSUE CULTURE STUDIES ON RADIOPROTECTIVE ACTION OF ORGANOPHOSPHORUS COMPOUNDS SYNTHETIZED AT THE PHARMACOLOGICAL INSTITUTE. Adolphe, M.; Cheymol, J.; Deysson, G.; Chabrier, P. (Univ., Paris). Progr. Biochem. Pharmacol., 1: 501-6(1965).

Orthophosphoric acid trisubstituted derivatives were synthesized and those showing an anticholinesterase effect were tested for their radioprotective effects in x irradiated mice and HeLa cells in tissue culture. Of the 14 substances studied, only 4 had a weak radioprotective effect. Results were compared with anticholinesterase and antimitotic effects of the compounds. (C.H.)

18483 NEW THIODERIVATIVES WITH RADIOPROTECTIVE ACTIVITY. Cugurra, F.; Balestra, E. (Univ., Genoa). Progr. Biochem. Pharmacol., 1: 507-14(1965).

Two new thiol compounds, meso-2-3-dithiosuccinic acid (DTS) and dl-2-3-dithiosuccinic acid (DL) were synthesized and the pharmacological effects and radioprotective effects against various doses of x radiation were tested in mice and guinea pigs. DTS exerted a marked radioprotective effect in mice exposed to LD_{50} doses of x radiation while LD did not show a protective effect when given 1 hr after irradiation. Both compounds exerted a radioprophylactic activity. Preliminary results are from studies of the survival of Ehrlich carcinoma bearing mice submitted to x radiation exposure and treated with DTS, DL, and cysteine. (C.H.)

18484 STUDIES ON THE COMPARISON OF THE RADIOPROTECTIVE EFFECT OF AET AND ITS CYCLIC ANALOGUES. Sztanyik, L.; Varteresz, V.; Doeklen, Anna; Nador, K. ("Frederic Joliot-Curie" National Research Inst. for Radiobiology and Radiohygiene, Budapest. Inst. for Experimental Medicine, Hungarian Academy of Sciences, Budapest). Progr. Biochem. Pharmacol., 1: 515-21(1965).

Cyclic analogs of AET were prepared and the toxicity of the compounds and radioprotective effects in mice exposed to 730 R x radiation were compared with those of AET. An attempt was made to establish some relationship between the free SH-group content, the reductive capacity, inhibition of tissue respiration, toxicity, and radioprotective effect of the compounds. The compounds tested included aminoalkylmercapto- and alkylmercapto-derivatives of amidine, imidiazoline, and tetrahydropyrimidine containing 2 or 3 carbon atoms in the alkyl chain. None of the compounds tested had a greater radioprotective effect than AET. (C.H.)

18485 GUINEA-PIG SKIN AND VICIA FABA IN TESTS OF CHEMICAL PROTECTION AGAINST X-IRRADIATION. Maggiora, A.; Lozeron, H.; Bujard, E.; Jadassohn, W. (Univ., Geneva). Progr. Biochem. Pharmacol., 1: 528-32(1965).

Guinea pig skin and Vicia faba roots were used as test systems for examining the protective effect of a number of substances against x rays. These tests provide means for examining this phenomenon other than the usually employed method of lethality in mice. The results obtained with these tests are in agreement in general, but exceptions seem to exist. (auth)

18486 X-RAY PROTECTION BY MEANS OF PANTOTHENIC ACID. Szorady, I.; Toth, Gy.; Gazdag, I. (Univ., Szeged). Progr. Biochem. Pharmacol., 1: 533-6(1965).

The protective effects of pantothenic acid against the effects of 500 R whole-body x irradiation were studied in 4 groups of mice. Pantothenic acid administered at a daily dose of 0.5 mg for a week with irradiation delayed for one week gave a better protective effect than when administered immediately before or after irradiation. Possible reaction mechanisms involved are discussed. (22 references.) (C.H.)

18487 PROLONGATION OF THE RADIO-PROTECTIVE EFFECT OF SEROTONIN. Belokonski, Il.; Manoloff, E. (Inst. of Radiology and Radiation Hygiene, Sofia). Progr. Biochem. Pharmacol., 1: 537-41(1965).

Serotonin (5-hydroxytryptamine) has a powerful radioprotective effect but its use in the prevention of radiation sickness is limited by the fact that it is inactivated quickly in biological systems and must be given 10 to 20 min before irradiation to be effective. The possibility of using oil and water-and-wax suspensions of serotonin to prolong the effective time was investigated in x irradiated guinea pigs, hamsters, rabbits, and rats observed for 30 days after treatment and irradiation. The serotonin preparations had a radioprotective effect when given from 1.5 hr up to 10 hr before irradiation. A new serotonin compound, serotonin-P-tolil sulfamide was prepared and tested, but it had no radioprotective effect. (C.H.)

18488 LATE CHANGES IN ANIMALS SURVIVED WITH THE HELP OF RADIOPROTECTIVE DRUGS AFTER LETHAL IRRADIATION. Dimitrov, L. (Higher Medical Inst., Sofia). Progr. Biochem. Pharmacol., 1: 550-3 (1965).

Mice were given various doses of 5-HT, AET, and MEA, or various combinations of these chemicals before or after exposure to 700 to 800 R x radiation. At the 5th month after treatment the surviving mice were examined for changes in body weight, changes in the incorporation of ^{14}C-thymidine and ^{3}H-adenine into DNA, and tissues were examined for histological evidence of change. The results showed that serotonin (5-HT) exerts a protective effect after exposures up to 800 R, that combined applications of the 3 compounds increased the resistance of mice to 800 R, but that late pathological effects are produced, especially after a single administration of serotonin. (C.H.)

18489 PROTECTION AGAINST IONIZING RADIATIONS BY COMPOUNDS FROM THE SERIES OF PHENYL-HYDROXYBENZOPYRONE. Gazave, J. M.; Modigliani, D. C.; Ligny, G. (Univ., Paris). Progr. Biochem. Pharmacol., 1: 554-7(1965).

The radioprotective effects of two compounds of phenylhydroxybenzopyrone, 5-7-dihydroxy isoflavine and 5-7-dihydroxy isoflavone, were investigated in mice exposed to 700 R x radiation. There was no protection when the compounds were given intraperitoneally but an excellent protective effects was observed when either of the compounds was administered percutaneously either before or after radiation exposure. Possible reaction mechanisms involved are discussed briefly. (C.H.)

18490 THE RADIATION PROTECTING ACTION OF SODIUM 4-HYDROXYBUTYRATE AND RELATED COMPOUNDS. Laborit, H.; Dana, M.; Carlo, P. (Research Center for Physiology and Pharmacology, Paris). Progr. Biochem. Pharmacol., 1: 574-9(1965).

The radioprotective effects of Na-4-hydroxybutyrate and related compounds were investigated in x irradiated mice. Difficulties were encountered in the determination of $NADP \cdot H_2$ due to its instability. Although this work needs further confirmation, it nevertheless offers a new approach to the problem of protection against ionizing radiation, and to the radiobiological problem of the destruction of free radicals through their reduction by the hydrogen of $NADP \cdot H_2$. Although the protection obtained with 4-OHB is less marked than with other agents such as AET or cysteamine, it may present an important theoretical interest if the hypotheses offered can be confirmed. 4-OHB offers also a practical interest: its general and anesthetic properties currently used in medicine, its low toxicity added to its radiation protecting action, justify the recommendation that it be used in long x ray explorations performed under anesthesia. (auth)

18491 RADIOPROTECTIVE ACTION OF PROCHLORPERAZINE IN EXPERIMENTAL TOTAL BODY IRRADIATION WITH A ^{60}Co SOURCE. Bergonzini, R.; Vendrame, L.; De Maria, D.; Morini, M. (Univ., Modena, Italy). Progr. Biochem. Pharmacol., 1: 580-5(1965).

The radioprotective action of prochlorperazine was studied in γ-irradiated mice. This compound was found to afford protection at sub-lethal doses of 700 R but it gave very little protection at doses of 800 to 850 R. Results are compared to the effects of cysteamine, which exerts a radioprotective effect at 800 to 850 R. (C.H.)

18492 RECOVERY FROM X-IRRADIATION AS PROMOTED BY THE ADMINISTRATION OF DNA. Tubiana, M.; Paoletti, C. (Institut Gustave Roussy, Villejuif, France). Progr. Biochem. Pharmacol., 1: 591-8(1965).

The restorative effect of DNA was studied in mice following 700 R of x rays (whole-body exposure). A total of 280 mice were used, divided into 7 groups of 40. AET + thiogel, a combination which selectively protects the digestive tract, was given orally before irradiation to two groups. In one of these groups, DNA was injected intraperitoneally (1 mg/mouse) after irradiation. A third group received only DNA, and a fourth group received only saline, injected intraperitoneally after irradiation. The three other groups provided non-irradiated controls. In the irradiated groups, the untreated mice and the mice treated only with DNA died within 20 days of irradiation. In the groups treated with AET + thiogel recovery, judged by the number of leukocytes and by body weight, occurred significantly earlier in the group which also received DNA. The late lethality was also slightly less in this DNA-treated group. (auth)

18493 RADIOPROTECTIVE ACTIVITY OF AN ETHEROLOGUS ACELLULAR SPLEEN EXTRACT. Muto, V.; Cifaldi, S.; De Franciscis, P. (Univ., Naples). Progr. Biochem. Pharmacol., 1: 599-603(1965).

Results are reported from research performed on homogenous groups of young male mice submitted to a single total-body x irradiation (600 R, a dosage almost 100% lethal), in which the protective action of fractions from a calf spleen extract, obtained through hydroxilapathite column elution were tested. Two fractions eluted with 0.02 and 0.04 M phosphate buffer in one preparation and the fraction eluted with 0.08 M buffer (another preparation) showed a striking protective action, reducing the post-irradiation mortality. The irradiated animals were observed for 100 days. (auth)

18494 LYSOZYME AND OTHER BASIC PROTEINS ACTING AS PROTECTORS ON THE BONE MARROW OF ANIMALS IRRADIATED AND OF ANIMALS TREATED WITH RADIOMIMETIC SUBSTANCES. Teti, M. (Univ., Messina, Italy. Catholic School of Medicine, Rome). Progr. Biochem. Pharmacol., 1: 604-15(1965).

Results are reported of research, carried out on rabbits and guinea pigs, to show the value of pretreatment at low doses (10 mg/kg, twice a day for 7 days) with lysozyme and other basic proteins to protect the animal, either from the damage or from the cytotoxic action of cytostatic drugs. Associating such basic proteins with cyclohexanol succinate (Radioplex) the results are particularly effective. The latter substance has, in fact, a clearly radiosensitizing action; used in high doses (600 mg/kg) it causes a bone marrow maturative block both of the granuloblastic and the erythroblastic series: such a phenomenon does not appear when small doses are administered (200 mg/kg) although they are inducing radiosensitization as well. If, before x radiation therapy or cytostatic treatment, basic proteins and cyclohexanol succinate are administered, a protective action on the bone marrow is ensured at the same time as radiosensitization. This may allow that the same cytostatic doses actually used in therapy will exhibit a stronger action (radiosensitization with cyclohexanol succinate) with lesser damage (protective action of the basic proteins on the bone marrow). (auth)

18495 RECOVERY EFFECT OF HIGHLY POLYMERIZED DEOXYRIBONUCLEIC ACID ON LETHALLY IRRADIATED ORGANISMS. Becarevic, A.; Kanazir, D.; Petrovic, S.; Jankovic, V. (Inst. of Nuclear Science "Boris Kidrich", Belgrade). Progr. Biochem. Pharmacol., 1: 616-21(1965).

Homologous native DNA or RNA extracted from the liver or spleen of young rats were found to have a radioprotective

effect in mice. The mechanism involved in the radioprotective effect of DNA was investigated at the biochemical level. Results are reported from studies on the effects of homologous highly polymerized DNA on the metabolism of nucleic acids of lethally x irradiated rats in which ^{14}C-orotic acid was used as a tracer of RNA synthesis in liver and ^{14}C-formate was used as a tracer of DNA and RNA synthesis in the intestinal cells. Data are presented on the effects of homologous native DNA on metabolic activity of liver RNA or irradiated and non-irradiated rats at different times after irradiation, the specific activity of RNA pyrimidines of subcellular RNA fractions of liver cells and intestinal RNA purines, and the incorporation of ^{14}C formate into DNA constituents. The data suggest that injected DNA provokes a depression of the metabolic activity of the cells and in irradiated animals this may provide a radioprotective effect. (C.H.)

18496 THE MODE OF ACTION OF BACTERIAL ENDOTOXIN AS A RADIOPROTECTIVE AGENT IN MICE EXPOSED TO LETHAL WHOLEBODY X-IRRADIATION. Wilson, R.; Ledney, G. D.; Matsuzawa, T. (Univ. of Notre Dame, Ind.). Progr. Biochem. Pharmacol., 1: 622-6 (1965).

The radioprotective effect of Escherichia coli endotoxin was investigated in x irradiated germ-free and conventional mice. The physiological effects produced by endotoxin were studied. It is postulated that the radioprotective effect of bacterial endotoxin is potentiated by the vasoconstrictive effects of endotoxin, which cause hypoxia persisting for several days and the reduced Po_2 may stimulate hemopoiesis and consequent acceleration of recovery, as well as protection, of tissues against radiation injury. (C.H.)

18497 RADIOPROTECTIVE EFFECTS AGAINST RADIATION BY NUCLEOPROTEINS OF LYOPHILIZED SPLEEN AND BONE MARROW. Reggiani, G.; Pipino, G.; Podesta, A. M. (Univ., Genoa). Progr. Biochem. Pharmacol., 1: 627-33(1965).

Lyophilized extracts of calf bone marrow, spleen, and thymus had a decided radioprotective effect on rats when injected intraperitoneally 1 to 3 hr after exposure to 850 R x radiation. Best results were obtained with spleen extracts. Results are included from the histological examinations of spleen and hematopoietic tissues of surviving animals examined from 12 to 60 days post radiation. The protected rats showed complete restoration of spleen by the 50th or 60th day after irradiation. It is postulated that the radioprotective effect is potentiated by an inhibitory effect on depolymerization of DNA of desoxyribonuclease. (C.H.)

18498 EFFECT OF 5-BROMODESOXYURIDINE AND OF MERCAPTOETHYLAMINE ON THE SURVIVAL RATE OF WHOLE-BODY IRRADIATED A-JAX MICE. Magdon, E. (Robert-Roessle-Klinik, Berlin). Radiobiol. Radiotherap., 6: 671-5(1965). (In German).

Radioprotective effects of 5-bromodesoxyuridine and MEA given separately and in combination were studied in Ajax mice exposed to 500 R whole-body doses of x rays. Administration of 5-BUdR either before or after irradiation did not significantly influence leukocyte counts or survival time. Leukocyte counts were slightly increased in irradiated animals given MEA, and survival time in these animals approached those of the unirradiated controls. In irradiated animals treated with a combination of 5-BUdR and MEA, leukocyte counts and survival times were increased significantly over those given 5-BUdR alone, but were considerably lower than in those mice given MEA alone. (H.G.D.)

18499 CYTOCHEMICAL AND CYTOSPECTROPHOTOMETRIC STUDY ON THE LEUKOCYTES OF RATS EXPOSED TO INTERNAL IRRADIATION WITH ^{32}P. III. UTILIZATION OF A VITAMIN COMPLEX AS RADIOPROTECTOR. Turcu, G.; Vasilescu, V.; Ciures, Al.; Albu, A. St. (Inst. de Medecine et Pharmacie, Bucharest). Rev. Roum. Biochim., 2: 165-75(1965). (In French).

Morphological, enzymatic, and nuclear modifications were determined on the leukocytes of rats subjected to internal irradiation with ^{32}P and fed on a diet containing hydrosoluble vitamin complex. The results obtained show that the enzymatic activity of granulocytes found in the circulating blood during irradiation is influenced by the vitamins, which also exert an influence on the quality of the lymphocyte nuclear (material) substance in that they attenuate the effects of irradiation. (auth)

18500 ON THE INFLUENCE OF ERYTHROPOIETIN ON ERYTHROPOIESIS INHIBITED BY RADIATION AND CYTOTOXICITY. Kuenkel, Hans A.; Mauss, Hans-Joerg; Klapheck, Ursula (Univ., Hamburg). Strahlentherapie, 129: 263-72(Feb. 1966). (In German).

An artificial anemia was produced in animals by bleeding. The serum was transferred to normal animals and a stimulation of erythropoiesis was noted. This stimulating effect of the erythropoietin could be shown by determining the incorporation rate of radioiron into the newly produced erythrocytes. The problem of whether and under which circumstances erythropoietin is able to increase the production of erythrocytes in animals which have bone marrow damage due to ionizing radiation or sublethal doses of 2,3,5-tris-ethyleniminobenzoquinone (trenimon) is considered. It was observed that whole-body irradiation with 800 R as well as 3 injections of 0.16 mg of trenimon per kg body weight damages the erythropoietic system of the animals to such an extent, that serum, containing erythropoietin, is without effect. In animals that received total body irradiation with 200 or 400 R as well as in the ones that received partial body irradiation with 800 R the inhibition of the erythrocyte production can be annulled partly by erythropoietin. (auth)

18501 THE RADIOPROTECTIVE EFFECTS OF PSYCHOTROPIC DRUGS. Locker, Alfred; Ellegast, H. (Reaktorzentrums, Seibersdorf, Austria, Univ., Vienna). Strahlentherapie, 129: 273-81(Feb. 1966). (In German).

The psychotropic drugs Valium, Taractan, Tryptizol, and Insidon, respectively, exert a protective effect in mice (10 to 30% survival within 30 days), if applied in optimal doses intraperitoneally 15 min before irradiation with x rays of 800 R. These effects are partially significant. With Taractan, an improvement of the radioprotection can be brought about until 73% survival, if irradiation takes place 90 min after injection, i.e., at the time of maximal depression of whole-body metabolism and of body temperature. (auth)

18502 AN EVALUATION OF TYROSINE, TRYPTOPHAN, AND DOPA AS AGENTS CAPABLE OF PREVENTING DEPIGMENTATION OF THE HAIR OF MICE SUBJECTED TO X-RAY IRRADIATION [Thesis]. Crowl, Robert Harold. Columbus, Ohio, Ohio State Univ., 1964. 59p.

The effects of substrates normal to the melanogenetic process in preventing depigmentation in the hair of mice subjected to x-ray irradiation were studied. The chemical agents used were tyrosine, dopa, tryptophan, phenylalanine, and sodium ribonucleate. Animals received 630 R of x rays. Results indicated that dopa was effective in reducing depigmentation in the animals of C57BL/6J and C57BL/6J-Cc genotypes when it was administered in single doses of 10 mg within five minutes before irradiation; dopa was effective when a single dose of 10 mg was administered within five minutes after irradiation to animals of C57BL/6J-Cc genotype; and a positive effect resulted from the daily administration of 10 mg of dopa for twenty-five days, with the initial dose given twenty-four hours after irradiation to animals of the C57BL/6J genotype. None of the other agents produced any significant reduction of depigmentation in any of the genotypes used regardless of time of administration or amount of agent injected. The results are explained by postulating a process whereby dopa is absorbed or phagocytized by melanocytes, in which it undergoes autoxidation and is incorporated into the developing hair cells. It is suggested that the failure of the other genotypes to produce some pigmentation in a like manner is due to the different physiological states of the follicular environment resulting from these genotypes. (TCO)

Radiation Hazards and Protection

See also HEALTH AND SAFETY

18503 (AD-611869, pp 169-83) RADIATION BIODOSIMETRY AND SCREENING FOR RADIOPROTECTIVE COMPOUNDS. Levinson, Hillel S.; Garber, Esther B. (Army Natick Labs., Mass.).

The release of intracellular materials (in particular, inorganic phosphate) from irradiated microorganisms forms the basis for using microorganisms in radiation dosimetry. Biodosimetry will be most useful where radiation inactivation of microorganisms is experimentally desirable (i.e., radiation preservation of foods), and will have the greatest advantage in the detection of changes in conditions of irradiation which might remain undetected in chemical dosimetry. Saccharomyces cerevisiae is suggested as one of the biodosimeter species because this organism is produced under uniform conditions at very low cost, is available commercially, and, on radiation, releases easily measurable phosphate into the suspending medium. Although with bakers' yeast, the range of the dosimeter is limited (ca 4×10^5 to 1.4×10^6 rads), the system can probably be extended by using other, more resistant, microorganisms, especially spores of bacteria. Yeast suspensions were irradiated with several substances reported as protecting microorganisms and mammals from the lethal effects of radiation. In every case (ascorbic acid, MEA, sodium thioglycolate, thiourea, and cysteine), these radioprotective substances inhibited release of yeast phosphate, although colony-forming capacity of yeast cells was unprotected. The use of the system as a screening procedure for radioprotective compounds is suggested. Tris and sodium cacodylate offer interesting possibilities as simple broad range dosimeters. Irradiated Tris buffer gives a positive ninhydrin test for amino-N, linear with dose from approximately 2×10^5 to 2×10^6 rads. Irradiated cacodylate gives a positive Fiske-SubbaRow test, with a linear response to approximately 4×10^6 rads. (auth)

18504 VARIATIONS OF THE LEUKOPENIC EFFECTS OF CYCLOPHOSPHAMIDE ASSOCIATED WITH PANIRRADIATION IN RAT, IN RELATION TO THE USE OF RADIOPROTECTIVE DRUGS. Martinenghi, C.; Stoppa, I. M.; Agati, G. (Univ., Milan. Univ., Turin). Progr. Biochem. Pharmacol., 1: 558-63(1965).

Results are reported from an investigation aimed at showing, by means of a quantitative test chosen for its simplicity and for its biological importance, the possibility of modifying, by means of specifically protective drugs and with drugs able to stimulate leukopoiesis, the progression of leukopenia induced in rats by irradiation and antimitotic drug. Results seem to indicate the possibility that the different drugs used have a selective action, at least in relation to the leukocytic test of rats. In fact, while DPN has revealed a notable protective efficacy, limiting leukopenia and favoring leukocytic recovery, cysteamine, which with other biological tests has shown itself to possess a radioprotective action, did not attenuate the leukocytic fall induced in the rats by irradiation with the antimitotic drug, thus showing itself to be practically ineffective. Ascorbic acid, Albema and Steranabol, which do not seem to be able to attenuate leukopenia, reveal an evident stimulating action in the recovery phase with a more rapid return of the leukocytes toward normal levels. (auth)

18505 THE RADIATION EXPOSURE OF PATIENTS AND RADIOLOGICAL EMPLOYEES IN HEART PROBES AS WELL AS CONTRAST MEDIUM REPRESENTATIONS OF THE HEART AND THE LARGE BLOOD VESSELS. PART II. MEASUREMENTS ON AN APPARATUS FOR PHOTOGRAPH SERIES IN TWO IMAGE LEVELS IN THE LARGE FILM FORMAT AND ON A FILM-HOLDER CHANGER—THE SCATTERED RADIATION EXPOSURE OF INVESTIGATORS UNDER PROTECTIVE CLOTHING. Schulte-Brinkmann, Wolfgang (Univ., Duesseldorf). Strahlentherapie, 129: 295-307(Feb. 1966). (In German).

The skin dosage (SD) of 110 patients (angiocardiography and thoracic aortography, respectively) was determined by measuring the SD-rate at a phantom with a bi-plane roller-film-changer using large film size. In addition, measurements of the dose to the male gonads were done. During heart soundings, an inverse relationship between age and body size, respectively, and amount of gonadal dose could be observed. Measuring the scattered radiation exposure, the highest exposure was found to be in hospital aides who had to hold children during angiocardiographic procedures. The examiner receives a higher exposure by scattered radiation during serial pictures done with manual injection of the contrast medium (lever-pressure-syringe) than those done with automatic injection. The SD-rate was also determined in a film-box changer using a phantom. There was considerable influence upon the amount of gonadal dose by field deflection as well as by the lead protection of the testes. Finally, results obtained with argon chambers under the lead-rubber-apron of the examiner, are reported, during a total of 138 cardioangiological examinations over a period of 52 working days. (TCO)

18506 X-RAY EXPOSURE DURING PREGNANCY. Gitlin, Joseph N.; Brown, Morton L.; Roney, Paul L.; Moore, Raymond T. (Public Health Service, Washington, D. C.). 52p. (CONF-651060-5). ORAU. Gmelin, AED-CONF-65-318-10.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Survey findings on prenatal x-ray exposure of mothers of live births during 1963 are presented. Medical and dental x-ray visits were determined in relation to age, trimester of pregnancy, number of previous births, race, income, and geographic location. The estimated annual visit rates for pregnant women were significantly lower than those for women of ages 15 to 44 in the general population. (H.G.D.)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 18305, 19052, and 19084.

18507 (BNL-10009) COMPARATIVE THERAPEUTIC EFFICACY OF HIGH-VERSUS LOW-LET RADIATIONS. Bond, V. P.; Robinson, C. V.; Fairchild, R.; Tisljar-Lentulis, G. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT(30-2)-Gen-16. 37p. (CONF-651143-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Conference on Radiobiology and Radiotherapy, Colorado Springs.

Possible approaches in radiotherapy using high-LET radiations are discussed. Included are neutron capture therapy; accelerator beams, particularly protons and negative Pi mesons; fast neutrons; and the influence of changes in cell survival curves on possible efficacy of high-LET radiations. An effort was made to present objectively the advantages and difficulties of the various approaches. It is possible, in principle, that these approaches may provide effective modalities for therapy, and in particular, that high-LET radiation may aid in overcoming the problem of relative protection of tumor cells located in hypoxic areas within neoplasms. In all approaches, it is necessary to consider carefully the concomitant changes in shape of dose-cell survival curves that accompany the change from low- to high-LET radiation. It is clear that while all proposed approaches have intriguing features, each requires considerably more work before it can be shown to be a useful adjunct in radiotherapy. (auth)

18508 (BNL-10038) PROBLEMS OF NEUTRON CAPTURE THERAPY. Atkins, Harold L. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT(30-2)-Gen-16. 23p. (CONF-660312-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Nederlands Atoomforum, Utrecht, Netherlands.

Neutron capture therapy remains a fascinating possibility in the treatment of human malignancy. Clinical trials using a thermal neutron beam and boron-10 were unsuccessful

in eradicating brain tumors because of poor, nonhomogenous penetration of the neutrons. In attempting to obtain an adequate flux at the tumor depth, more superficial tissues received radiation doses beyond the tolerance level. Subsequent studies have established tolerances to thermal neutrons. An epithermal neutron beam has been developed which is capable of supplying an adequate thermal neutron flux at depth should a compound of a capture nuclide be found which will concentrate sufficiently in tumors. The parameters necessary for practical neutron capture therapy have been defined. Recent work indicates that ^{157}Gd, with a cross section of 240,000, which can be prepared as a stable colloid of Gd_2O_3, may be a useful neutron capture agent for certain special applications. (18 references.) (C.H.)

18509 (UCLA-12-576, pp 61-80) NUCLEAR MEDICINE. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology).

Radioisotope scanning methods for lung visualization and functional evaluation after the intravenous injection of ^{131}I-human serum albumin as macroaggregates or by the inhalation of various radioaerosols are described. Results of clinical trials in 500 patients are summarized. Scanning with ^{131}I serum albumin aggregates was used in studies of the effects of bronchial obstruction on regional pulmonary blood flow in dogs, measurements of regional cerebral blood flow by temporary arteriolar blockage in monkeys, and brain scanning in monkeys. Radioisotope procedures for the measurement of kidney function and diagnosis of renal disease are described. Results are reported from studies on the effects of freezing, lyophilization, and exposure to x radiation on viability and metabolism of Staphylococcus aureus; the immunogenic activity in mice of a Brucella melitensis vaccine prepared from γ irradiated bacteria; a study of the content of body K in diabetic patients as determined by whole-body counting of ^{40}K; the tissue distribution of ^{99}Tc in rabbits as compared with the bone-seeping tracers ^{47}Ca and ^{85}Sr; the effect of AET in DMSO on the survival time of mice exposed to γ radiation; the development of a Fortran IV computer program for the rapid evaluation of post-irradiation survival times in animals; and studies of the physiology of mouse thymus cells in culture. (C.H.)

18510 THE USE OF X-RAY TELEVISION IN PRACTICE. Eggs, Franz; Dietz, Werner (Eggs-Dietz Roentgeninstitut, Freiburg i.B.). Aertzl. Forsch., 18: 480-5 (Sept. 10, 1964). (In German).

The need for reduction of doses received by patients and radiologists during fluoroscopy is discussed and means of achieving this through television equipment are presented. Some dosimetry data obtained with conventional fluoroscopy and by use of television are reported. (TCO)

18511 A VAGINAL ^{60}Co APPLICATOR FOR INTRAVAGINAL IRRADIATION. Ariel, Irving M. (Pack Medical Foundation, Inc., New York). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 570-3(Mar. 1966).

A vaginal ^{60}Co applicator designed for the post-hysterectomy radiotherapy of uterine cancer and for the treatment of intravaginal cancerous recurrences and metastases is described. Although the applicator is safe and efficiently destroys cancer within the immediate center of the applicator, the rapid falloff as demonstrated by the isodose curves, precludes use of the technique at any distance from the site of the immediate vagina. (H.G.D.)

18512 AN UNUSUALLY HIGH NASAL UPTAKE OF RADIOACTIVE IODINE DURING TREATMENT FOR CARCINOMA OF THE THYROID. McCready, V. R. (Royal Marsden Hospital, Surrey, Eng.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 593-5(Mar. 1966).

A case is reported in which an unusually high nasal concentration of radioiodine administered for therapy of a thyroid carcinoma posed a diagnostic pitfall. The high activity found in the nasal cavity could not be explained. (H.G.D.)

18513 A CRITICAL ANALYSIS OF STRONTIUM BONE SCANNING FOR DETECTION OF METASTATIC CANCER. Charkes, N. David; Sklaroff, Daivd M.; Young, Irving (Albert Einstein Medical Center, Philadelphia). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 647-56(Mar. 1966).

Evaluation of more than 350 bone scans in cancer patients with proven or suspected metastases has shown ^{85}Sr to be an effective agent for the detection of occult tumors. Biopsy studies in 26 patients indicate that radiostrontium deposits in the new bone formed in reaction to the presence of cancer. Specific uses of bone scans, pitfalls in interpretation, and disadvantages of ^{85}Sr are discussed. (auth)

18514 COMPUTER GENERATION OF NORMAL VALUES FOR THYROID ^{131}I UPTAKES. Hoffmann, Robert G.; Williams, Clyde M. (Univ. of Florida, Gainesville). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 727-30(Mar. 1966).

A computer program written in Fortran for the IBM-709 is described that performs the following operations on unselected consecutive tests: computes the normal range; determines whether the testing procedure was stable; and transforms the test measurement scale to one based on the normal range. The program was tested on 650 consecutive cases of patients with suspected thyroid disease, referred to the Department of Radiology of the University of Florida College of Medicine, on whom follow-up information of at least 6 months was available. The validity of the computed normal range of 24 hour ^{131}I uptakes was established by examining the distribution of euthyroid patients after their status was determined clinically. (auth)

18515 CYCLOTRON PRODUCED SHORT-LIVED RADIOACTIVE ISOTOPES. Ter-Pogossian, Michel M. (Washington Univ., St. Louis). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 737-43(Mar. 1966).

A cyclotron installed at the Washington University Medical Center for the production of short-lived radioisotopes is described. A great number of short-lived radioisotopes potentially useful in medicine may be prepared by the cyclotron. However, the most important ones appear to be ^{15}O, ^{11}C, and ^{13}N, and medical uses of these are briefly reviewed. For most medical applications the simplest target material to be used is air, which is bombarded at normal temperature and pressure. (H.G.D.)

18516 THE RADIOTHERAPEUTIC POSSIBILITIES OF NEGATIVE PIONS. PRELIMINARY PHYSICAL EXPERIMENTS. Richman, Chaim (Graduate Research Center, Dallas, Tex.); Aceto, Henry Jr.; Raju, Mundundi R.; Schwartz, Bernard. Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 777-90(Mar. 1966). (UCRL-16302).

Physical properties of negative pions are reviewed. Measurements by ionization chambers and LiF dosimeters of the doses from the pion beam as a function of range in a Lucite phantom are reported. Attenuation of the beam was studied by counting the particles with scintillators, and flux-density distribution was measured in a plane perpendicular to the beam. Energy release in the stars at the end of the range was investigated with silicon semiconductor detectors. Electron background in the beam was also examined. (H.G.D.)

18517 THE SELECTION OF A CONTRAST MEDIUM FOR BRONCHOGRAPHY: HYTRAST. Belli, I.; De Santis, L. A.; Ceriana, G. Ann. Radiol., 8: 651-63(1965). (In French).

Brief mention is made of the indications of bronchographic technique, and a review is presented of the ideal properties of the contrast media; the advantages and the disadvantages of the oily product and of the aqueous product are discussed. A recently introduced contrast medium for bronchography (Hytrast), in which almost all the characteristics of the ideal contrast medium appear to be combined, is assessed. (auth)

18518 TANTALUM SCREENS FOR IMAGE INTENSIFICATION IN RADIOGRAPHIC EXPOSURES. Moeller, Hermann; Weeber, Helmut (Max-Planck-Institut fuer Eisenforschung, Dusseldorf). Arch. Eisenhuettenw., 36: 843-9(Nov. 1965). (In German).

Investigation of the properties of intensification screens

of Ta and Pb in radiography in the energy region from 0.3 to 31 Mev was carried out. The ratio of photograph effectiveness of primary radiation and scattered radiation and lack of sharpness were studied for both metals. These values were used to determine darkening distributions. The necessary attenuation coefficients for primary radiation were determined in separate measurements. At high energies Ta screens gave better results than Pb screens with respect to image sharpness, while the scatter ratio and ground contrast were approximately the same. Further improvement of the image sharpness was gained by removal of the back screen; this also worsened the ground contrast slightly. It is thus advantageous to use Ta screens before the film in the high energy region; cost analysis indicates the high original cost of the Ta screen involves no real increase in cost. (BBB)

18519 A CASE OF HEMOCYTOBLASTOSIS DEVELOPING AFTER RADIUM THERAPY OF RETICULOSARCOMA OF THE MEDIASTINUM. Melikova, M. Yu.; Badmaeva, V. V.; Vecher, A. M. Arkh. Patol., 27: 64-7(1965). (In Russian).

Reticulosarcoma of the mediastinum was treated with radium therapy in a 16-yr-old male patient in whom the disease had apparently been developing for 2 yr. The patient had experienced pain in the neck when swallowing, above-normal temperature, lethargy, shortness of breath, loss of weight, pallid skin, and pain below the sternum. An examination of the patient revealed: indurated lymph nodes along the external edge of the pectoral clavicular muscle with cells resembling lymphoblasts predominating in the nodes and surrounding fatty tissue; the entire anterior mediastinum was covered with neoplastic cells characteristic of those of lymphosarcomatosis, plus a few larger cells resembling those of reticulosarcoma. Based on these findings, radium therapy was given. A significant decrease in the size of the tumor and jugular lymph nodes resulted, the shortness of breath became more severe, but little immediate change in the overall condition of the patient was noted. However, after a week had passed a marked deterioration in his general condition took place; the temperature rose to 38°C, massive, widespread cutaneous hemorrhages occurred, symptoms of massive renal and intestinal extravasation of blood were noted, and the liver became enlarged. Hematologic analysis confirmed the presence of (80%) hemocytoblasts. Anemia became more pronounced and the patient died. This case illustrates the possibility of development of leukemia as a late complication of radiation therapy for reticulosarcoma. (BBB)

18520 PLACENTAL LOCALIZATION BY ARTERIOGRAPHY. Wingate, M. B.; O'Connell, N. D. (Southmead Hospital, Bristol, Eng.). Bristol Med.-Chir. J., 80: 50-2(July 1965).

Use of radiography to locate the placenta in 10 cases of antepartum hemorrhage is described, with an evaluation of its safety on the basis of resulting complications. At the present time the only certain method of diagnosing placenta previa in a pregnant woman with antepartum hemorrhage is by examination under anesthesia. The procedure is traumatic and may induce labor with or without further hemorrhage. For these reasons obstetricians have sought a method of placental localization which could be used at an earlier stage of pregnancy without danger to mother or baby. Many radiological methods to aid placental localization have been described, and include soft tissue studies, use of the hypaque pillow and differential filters, contrast filling of the bladder and rectum, placental calcification, amniography isotope studies with radioiodine-labeled serum albumin, and arteriograpy. In the procedure described, 20 ml of contrast medium is injected into the femoral artery, and one antero-posterior film of the abdomen is taken about four seconds after the end of the injection. The placenta can be readily visualized, the sinusoids being outlined by contrast medium as multiple irregular woolly areas. It was concluded that, with increasing experience, femoral arteriography is a comparatively simple and safe method of demonstrating the presence or absence of a placenta previa from the 32nd week of pregnancy. (BBB)

18521 PHYSICAL VIEWPOINTS ON THE USE OF DIFFERENT TYPES AND QUALITIES OF RADIATION IN THE TREATMENT OF DISEASE. Pohlit, Wolfgang (Max-Planck Institut fuer Biophysik, Frankfurt am Main). Fortschr. Kiefer. Gesichtschir., 8: 3-8(1962). (In German).

Dosimetry in tumor radiotherapy is discussed for conventional x rays, ^{60}Co γ rays, and 15 to 30 Mev electrons. (H.G.D.)

18522 ^{90}Sr–^{90}Y EXTRACORPOREAL IRRADIATOR. Libby, R. L.; Frey, H. S.; Craddock, C. G.; Martin, D. C. (Univ. of California, Los Angeles). Int. J. Appl. Radiat. Isotop., 17: 201-4(Apr. 1966).

The design criteria and the calculated and measured transit dose rates in rads for a $^{90}Sr-^{90}Y$ extracorporeal radiation source are described. The advantages of a system employing β particles instead of x or γ radiation are discussed. (auth)

18523 RADIATION THERAPY OF ORAL CARCINOMA, I. EFFECTS ON ORAL TISSUES AND MANAGEMENT OF THE PERIODONTIUM. Silverman, Sol Jr.; Chierici, George (Univ. of California, San Francisco). J. Periodontol., 36: 478-84(Nov.-Dec. 1965).

Earlier data are reviewed and new results presented relating to effects of radiation on oral structures in humans and laboratory animals. Most patients develop a tan or burn of the skin when the irradiation source is extraoral, along with suppression of hair growth and varying degrees of a painful mucositis which often prevents eating. Patients also develop loss of taste during therapy. When the salivary glands are included in the field of irradiation, varying degrees of fibrosis, fatty degeneration, acinar atrophy and cellular necrosis take place. Because of the mucositis, loss of taste, and partial xerostomia, anorexia is a common complaint; and together with the difficulty of mastication and swallowing, the patients uniformly lose weight. Indirect effects from the salivary changes predispose remaining teeth to caries and dental disintegration. Various animal studies designed to determine the effects of irradiation of periodontal structures are also considered. The results of human studies have been somewhat indeterminate because there has been inadequate description and correlation of criteria for assessing osteomyelitis or osteonecrosis, the variables of radiation energy, filtration, exposure fields, dose rate, frequency of exposure, and the condition of the dental and paradental tissues. A table summarizes 7 reported series and indicates a 3 to 13% chance of a resultant osteomyelitis following irradiation of oral structures. Because of the cellular changes of periodontal tissues induced by irradiation, the increased risk of necrosis and infection in such patients must be considered. Because of the lack of consistent observations and controlled studies, formulae for managing pre- and postirradiation problems cannot be unequivocally derived. However, generalizations based on clinical experience and current knowledge of the biology of radiation are made. All teeth within the primary beam of radiation and any other teeth which have advanced caries or periodontal disease are removed. (BBB)

18524 USE OF LINEAR PROGRAMMING METHODS FOR SELECTING THE BEST CONDITIONS FOR THE REMOTE RADIATION THERAPY OF MALIGNANT NEOPLASMS. Oleinik-Ovod, Yu. A.; Klepper, L. Ya. Kibernetika, No. 5, 66-87(Sept.-Oct. 1965). (In Russian).

The following dose distribution conditions were used as the basis for optimizing the effect of irradiation on malignant tumors: the dose must be equal to a set value D in every point of the tumor, keeping the deviation below a certain ΔD; the desired boundary condition must prevail outside of the tumor; the dose should not exceed the critical level in vital organs; and the integral absorption dose in the whole organism must be kept at the lowest practicable level. Using a linear programming method, the possible directions, the number of the radiation sources and the distances between the sources and the skin were computed; determining the most effective combination of conditions for static, rotating, and oscillating radiation sources. A case of cancer of

the esophagus was chosen as typical. None of the optimal directions was satisfied by use of the rotating or oscillating method. It was concluded that stationary irradiation from the carefully calculated directions is more efficient than the other methods considered. (TTT)

18525 EVALUATION OF HEMOPOIESIS AND COMPARATIVE STUDY OF ^{32}P AND CHLORAMBUCIL THERAPY BY MEANS OF RADIOTRACERS IN POLYCYTHEMIA VERA. **Varela, J. E. (International Atomic Energy Agency, Vienna); Kremenchuzky, S.; Fraga, A.; Etcheverry, M. A.; Figueiras, H. Minerva Nucl., 9: 275-80 (Sept.-Oct. 1965).**

Chlorambucil was tested and compared against ^{32}P on the same group of patients. The ten cases presented were studied exhaustively by means of radiotracers throughout the course of their disease and before and after successive ^{32}P treatments. The same ten cases were thereafter treated with chlorambucil while relapsing after remission. Radiotracers were again used in order to evaluate the effect of therapy and compared it with the response to ^{32}P. Chlorambucil therapy was in all cases attempted at the beginning of a new period of relapse, but before the disease had entered its final course. The aim of the work was to find out whether it was possible to obtain normal hematological status and normal hematopoietic function by means of chlorambucil. Results indicate that chlorambucil therapy may certainly be an ideal alternative to ^{32}P therapy, may render positive results when ^{32}P has failed, or may also be used in combination with phlebotomy to ensure good remission. (TCO)

18526 EVALUATION OF ERYTHROPOIESIS BY MEANS OF ^{51}Cr LABELED ERYTHROCYTES. STUDY ON IRRADIATED CANCER PATIENTS. **Di Pietrantonj, F. (Univ., Genoa). Minerva Nucl., 9: 288-94(Sept.-Oct. 1965). (In Italian).**

Erythropoiesis was studied in patients undergoing telecobalt therapy for cancer. Erythrocytic production was determined by the ratio of erythrocytic mass to mean cell life. It was concluded that anemia-induction by radiotherapy is rare and is based on a temporary hyporegeneration. (H.G.D.)

18527 PERSONAL EXPERIENCE IN THE TREATMENT OF REAL POLYCYTHEMIA WITH ^{32}P. CLINICAL, HEMATOLOGICAL AND COAGULATIVE STUDY. **Manaresi, A.; Vancini, B.; Facchini, G.; Barbieri, L. L. (Univ., Bologna). Minerva Nucl., 9: 312-17(Sept.-Oct. 1965). (In Italian).**

The results obtained in 14 patients with polycythemia who were treated with radioactive phosphorus are reported. On the whole the results were good: true remission of the disease was obtained in 6 patients for more than 12 months using only one or two doses close together of ^{32}P; in 4 cases remission was only partial and further doses of radiophosphorus had to be administered at various intervals. It is not yet possible to evaluate the results in the 3 patients who were treated within the last 6 months. The normalizing action that this therapy exerts on clotting balance is pointed out. This balance can become thrombophilia and hemorrhagic syndrome by hypofibrinogenemia and hyperfibrinolysis. (auth)

18528 LONG-TERM RESULTS IN THE TREATMENT OF CUTANEOUS ANGIOMAS USING EXTERNAL β THERAPY WITH $^{90}Sr-^{90}Y$. **Faccini, M.; Moreschi, N. (Univ., Milan). Minerva Radiol., Fisioterap. Radiobiol., 10: 570-4(Nov. 1965). (In Italian).**

On the basis of the results obtained in the treatment of 142 cases of angiomas treated with $^{90}Sr-^{90}Y$ β therapy, it is concluded that this treatment gives satisfactory results. An irradiation procedure for the therapy of various types of angiomas is suggested. (J.S.R.)

18529 STUDY ON THE MEDICAL APPLICATIONS OF RADIOACTIVE MINUTE PARTICLES. **Uematsu, Sadao (Chiba Univ., Japan). Nippon Acta Radiol., 25: 72-81(Apr. 1965). (In Japanese).**

Medical uses of minute particles of labeled inorganic compounds are discussed. Capillary blockage by such particles makes possible the selective irradiation of tissues. The particles may be used diagnostically for abnormal blood flow and malignant tumors. (H.G.D.)

18530 RADIOISOTOPES IN ENDOCRINOLOGY. FIRST ANNUAL SESSION OF THE SOCIETY OF NUCLEAR MEDICINE IN FREIBURG i. Br., OCTOBER 17–19, 1963. **Hoffmann, G. (Univ., Freiburg i. B.). Nucl.-Med., 2: Suppl. 2, 1-479(1965). (In German). (CONF-631009).**

The 50 papers presented at the first annual session of the Society of Nuclear Medicine are compiled together with the discussions on the papers. The topics discussed are: morphology and the function of the thyroid, biochemistry of the thyroid hormone, radioiodine test of the thyroid function and the thyroid scanning, radioiodide test in routine diagnosis of thyroid function disorders, normal iodine activity of the thyroid, human metabolism, thyroid function diagnosis with ^{125}I and ^{131}I, detection and localization of low ^{131}I activities, discrepancies between radioiodine tests and clinical results, analysis of ^{131}I-labeled compounds in the blood, the basis of triiodothyronine uptake by erythrocytes, distribution of iodine hormones between plasma and erythrocytes and resin triiodothyronine uptake test, evaluation of triiodothyronine uptake test, thyroid functional test with radioiodine, modification of the radioiodine function diagnosis with endogenous and exogenous factors, effect of thiocyanide on iodine metabolism, effect of percutaneous thyroid irradiation, effect of antiproteolytics and hormones on thyroid hormone, problematics of radioiodine diagnosis in endemic goiter regions, comparison of intrathyroidal ^{127}I and ^{131}I metabolism and endemic and sporadic goiter, behavior of homoiostasis in endogenous iodine metabolism, suppression tests with triiodothyronine in goiter areas, pathogenesis of hyperthyroids, radioisotopes of the diagnosis of hyperthyroid states, radioresection of euthyreotic struma, radioiodine treatment in thyrotoxicosis, differential diagnosis, therapy, and pathophysiocology of toxic adenomas, management of thyroid cancer, radioiodine therapy of malign thyroid tumors, clinical scheroid analysis with ^{3}H and ^{14}C, a method for the determination of NNR secretion rates of cortisol, and dehydroepiandrosterone, intercellular use of radioisotopes, transsplenoidhypophysectomy with radio gold, partial resection of the hypophysis, primary and combined operative-sterotatic radioisotopic irradiation of hypophysis-adenoma, K distribution, distribution of noradrenalin in the body of the rat, the effect of protein efficient steroids, studies of skeletal metabolism, calcium metabolism, strontium mobility in the skeleton, determination of the heart volume, and scintillation of the scanning of the spleen. (J.S.R.)

18531 COORDINATE DETERMINATION IN IMPLANTED GAMMA EMITTERS. **Busch, M. (Univ., Freiburg i. B.). Nucl.-Med., Suppl. 3, 437-45(1965). (In German).**

A method for determining the dose distribution after interstitial use of radiogold seeds is described. The manually performed operation was limited to the measurement of the projected gold seeds from x-ray pictures in two planes. Steps that earlier made dose calculations very difficult were performed completely automatically by a programmed computer. These steps include: classification of the related measurement values with indication of the measurement error; correction of the central projection and elimination of the position errors in the preparation of x-ray pictures; calculation of the dose distribution in a random orthogonal intersecting plane; and expression of this distribution in scaled enlargement on a sheet of paper. (tr-auth)

18532 DESTRUCTION OF THE HYPOPHYSIS WITH $^{90}Sr-^{90}Y$. **Harper, P. V.; Strandjord, N.; Moseley, R. D.; Lathrop, Katherine A. (Univ. of Chicago). Nucl.-Med., Suppl. 3, 447-55(1965).**

A new method of transphenoidal radiative destruction of the hypophysis is described using a 54 mC sealed source of $^{90}Sr-^{90}Y$ in a No. 19 gauge needle. The method seems generally applicable and relatively free from complications. Preliminary results in 29 patients are encouraging. (auth)

18533 CHEMICAL RADIOPROTECTION AND TUMORS. Greco, S.; Gasso, G.; Billitteri, A. (Univ., Catania, Italy). Progr. Biochem. Pharmacol., 1: 277-305(1965).

Recent literature on the effects of various radioprotective compounds on the differential radiosensitivity of tumors and healthy tissues is reviewed. Data are presented from studies on the effects of cysteine, cysteamine, bioflavonoids, and Synkayvite on the radiosensitivity of transplanted mammary carcinomas in rats. Possible applications of the findings in tumor radiotherapy are discussed. (C.H.)

18534 COMBINED ACTION OF IRRADIATION AND CHEMOTHERAPY; EXPERIMENTAL STUDIES AND CLINICAL APPLICATION TEST. Chevallier, A.; Herdly, J.; Manuel, S.; Chateau, D. (Centre Paul Strauss, Strasbourg). Progr. Biochem. Pharmacol., 1: 634-41(1965).

Experiments carried out in rats, using the test of bone marrow cell counting, have shown that it is possible under certain conditions to observe combined effects of x irradiation and a radiomimetic agent (Endoxan, Cytoxan). Additional effects were obtained only with certain doses and precise methods of administration. The result was the same regardless whether the irradiation was confined locally to the bone marrow examined or was administered to the whole body. This procedure was applied in the ^{60}Co γ treatment of dark small cell bronchial tumors in man. It was found, after systematic measurement of the radiological shadows of the tumor, that additional effects had indeed been obtained. However, from the cancerological point of view, the application of this technique does not appear to have achieved any therapeutic progress; further, the combined treatment raised a number of problems. Further trials at present being conducted on epidermoid bronchial tumors are insufficiently advanced to give any valid appreciation of the treatment. (auth)

18535 PROTECTIVE AND THERAPEUTIC ACTION OF DPN. Oliva, L. (Univ., Siena, Italy). Progr. Biochem. Pharmacol., 1: 651-5(1965).

Experimental research in x irradiated rats demonstrated that pyridine diphosphate nucleotides (DPN) is active as a radiosensitizer and as a radioprotector. In the clinical field 8 to 16 mg daily of DPN administered simultaneously with the x ray therapy or at the beginning of the symptomatology produced a beneficial effect on radiation sickness, being more active on patients whose treatment was carried out together with the x ray therapy. No undesirable secondary effects were noted. (auth)

18536 CONTROL OF LONG DISTANCE X-RAY EFFECTS DURING PREGNANCY AND IN NEWBORNS. Bergamaschi, P.; Coucourde, F. (Univ., Pavia, Italy). Progr. Biochem. Pharmacol., 1: 656-62(1965).

Results are reported from a survey of 270 children who were exposed to x radiation from diagnostic radiography during their intrauterine life or early neonatal period. Intrauterine exposure usually occurred during the month before birth. Data were recorded on the radiation dose delivered to the skin of the mother or baby during radiographic examination. No pathological conditions were found in the children that could be attributed to exposure to x radiation during diagnostic radiography. (C.H.)

18537 SPINDLE POISONS IN RADIOTHERAPY. Bonomini, B.; Fiorentino, M. (Ospedale Civile, Padua). Progr. Biochem. Pharmacol., 1: 674-80(1965).

Compounds able to interfere with the mitotic rhythm (spindle poisons) are potential radiosensitizing drugs. One hundred and ten cases of radioresistant human tumors (mainly head and neck squamous cell carcinomas), most of which were in relapse after normal radiotherapy, were selected for clinical trial. They were divided into four groups, each group receiving a different mitotic poison associated with moderate doses of radiotherapy (2,000 to 3,000 R in 5 to 15 days). The results and the side effects are tabulated for colchicine, synthetic colchicine, podophyllin derivatives, and ethylic urethan. (auth)

18538 GENERAL CONSIDERATIONS ON THE RADIOSENSITIZING ACTION OF SODIUM CYCLOHEXYLSUCCINATE IN HUMAN THERAPY. Scolari, E. G.; Nannelli, M.; Vallecchi, C. (Univ., Florence). Progr. Biochem. Pharmacol., 1: 681-9(1965).

Sodium cyclohexylsuccinate was administered to a group of 446 patients, 333 with malignant tumors and the remainder with benign tumors, and a radiosensitizing effect of the drug was observed after radiotherapy. The pharmacology and toxicology of the drug was studied in guinea pigs, rabbits, and rats. It was found to have an antiglycolytic effect and a damaging effect on mitosis. A hypothesis is presented to explain the effect of the drug on glucose metabolism of tumors. (C.H.)

18539 CONTROLLED TRIAL OF THE RADIATION SENSITIZING EFFECTS OF 5 FU AND ACTINOMYCIN D IN HUMAN LUNG CANCER. Hall, T. C. (Harvard Univ., Boston). Progr. Biochem. Pharmacol., 1: 690-4(1965)

The radiosensitizing effects of 5-fluorouracil and actinomycin D in human lung carcinomas were evaluated in a group of 342 patients undergoing x radiation therapy. No difference was observed in the response of patients receiving either of these compounds. (C.H.)

18540 HALOGENATED PYRIMIDINES AS RADIOPOTENTIATORS IN THE TREATMENT OF STOMACH CANCER. Falkson, G. (Univ., Pretoria). Progr. Biochem. Pharmacol., 1: 695-700(1965).

The value of combined 5-fluorouracil and ^{60}Co γ radiotherapy for the treatment of stomach cancer was evaluated in 186 patients. Results showed that combined 5-fluorouracil and γ treatment was more effective than either treatment alone. Data are tabulated on dosage and patient response. (C.H.)

18541 MODIFICATION OF RADIATION RESPONSE OF TISSUE BY ACTINOMYCIN. PRELIMINARY CLINICAL EVALUATION. Griem, M. L.; Ranniger, K. (Argonne Cancer Research Hospital, Chicago. Univ. of Chicago). Progr. Biochem. Pharmacol., 1: 701-6(1965).

A comparative evaluation of the effects of actinomycin alone, x radiation alone, and of combined drug-radiation treatment was made in patients with round cancer metastases in both lungs. Of the 42 cases evaluated, 9 showed no response, 10 cases showed a response that could be due to x radiation alone or to combined drug-radiation treatment, and 23 cases showed a favorable response to combined drug-radiation treatment. Data are included on dose and treatment schedules. (C.H.)

18542 PHARMACOLOGICAL AND CLINICO-STATISTICAL FINDINGS ON THE RADIOSENSITIZING ACTION OF SODIUM CYCLOHEXYLSUCCINATE IN HUMAN THERAPY. Scolari, E. G.; Vallecchi, C.; Nannelli, M. (Univ., Florence). Progr. Biochem. Pharmacol., 1: 707-19(1965).

Results are reported from the treatment of 333 cases of cancer and 113 cases of benign neoplasms and non-tumoral conditions with sodium cyclohexylsuccinate and x radiation. A survey of results of treatment of the various groups of malignancies, primary tumors, metastatic tumors, radioresistant, and recurred tumors, led to the conclusion that therapeutic results were better when combined drug and radiation treatment was used than in a control group that received radiotherapy alone. (C.H.)

18543 PRIMARY CLINICAL-RADIOLOGICAL OBSERVATIONS ON THE USE OF 1-PHENYL-2 (p-HYDROXY-PHENYL)-3.5 DIOXY-4-n-BUTYL-PYRAZOLINE, AS A PROTECTIVE DRUG FOR PULMONARY TISSUES IN RADIOTHERAPY OF TUMORS OF THE THORAX. Noe, C. (Ospedale Maggiore, Milan). Progr. Biochem. Pharmacol., 1: 725-7(1965).

Fifty-two patients undergoing x radiation therapy of pulmonary tumors were treated with tanderil, an oxyphenyl derived from butazolydine. This anti-inflammatory drug proved effective in reducing the incidence of pneumonia that is often associated with radiotherapy. (C.H.)

18544 DOSE CALCULATION OF IONIZING RADIATION IN CERTAIN SECTIONS OF HUMAN ORGANISM IN THE TREATMENT OF DISEASES OF THE BLOOD SYSTEM WITH ^{32}P. Lapchenkov, V. I.; Belugina, S. T. (Roentgenradiologisches Institut, Leningrad). Radiobiol. Radiotherap., 6: 637-43(1965). (In German).

Methods for calculating the dose of ionizing radiation in some tissues of human organism in the treatment of polycythemia and leucoses with ^{32}P are presented. A simple and to most radiologists easily accessible scheme of calculation is proposed considering the most recent knowledge of the distribution of ^{32}P in organism by persons suffering from polycythemia and leucoses. This scheme is based on the principle of dividing the tissues into two components differing with regard to the uptake of ^{32}P from each other: the component of blood-forming tissues involving the active bone-marrow, liver, and spleen, and the component of soft and supporting tissues involving all the other tissues including the bone-tissue itself. Formulas for both components are given for dose calculation of ^{32}P during the total decay of the isotope. (auth)

18545 DISTRIBUTION OF MEGAVOLT THERAPY IN MAMMARY CARCINOMA. Keller, H. L.; Wachsmann, F. (Univ., Erlangen-Nuremberg, Ger.). Radiol. Austr., 15: 213-17(1964). (In German).

Phantom measurements were made to show the dose distribution with 200-kv x rays, ^{60}Co γ rays, and 6-, 12-, and 17-Mev electrons. Diagrams show the distribution of dose under conditions of fixed-field and rotation therapy with ^{60}Co. The distribution of the dose is not very satisfactory if large tangential fields are used for irradiation of the thorax wall in cases of breast carcinoma. A more desirable distribution is found if shell or tangential irradiation is used. Superficial shell radiation is more suitable than tangential irradiation. Extremely hard radiation such as ^{60}Co γ radiation is preferable to conventional (200-kv) x radiation. The best distribution of the dose is achieved with pendulum irradiation by fast electrons; homogeneous penetration of tissue layer (the size of which depends on the energy), and a very steep slope of the dose against the depth, with almost complete protection of the healthy tissues in the body, are obtained. (BBB)

18546 THE TWIN THEORIES OF ELECTROMAGNETIC RADIATION. Hermann, Richard W. (William Beaumont Hospital, Royal Oak, Mich.). Radiol. Technol., 37: 56-62(Sept. 1965).

Interpretation of the properties of electromagnetic radiations on the basis of particle and wave concepts is considered and applied to some problems in radiology. The most important and understandable observations upon which the two theories are based are the interference and reflection properties of waves and photons. Diffraction, the photoelectric and Compton effects, and quantum scintillation are dealt with in evaluating the merits of and difficulties introduced by the dual concept of electromagnetic radiation. (TCO)

18547 ANAPLASTIC TRANSFORMATION IN VERRUCOUS CARCINOMA OF THE ORAL CAVITY AFTER RADIATION THERAPY. Perez, Carlos A.; Kraus, Frederick T.; Evans, John C.; Powers, William E. (Washington Univ., St. Louis. Yeshiva Univ., New York). Radiology, 86: 108-15(Jan. 1966).

The results of radiation therapy in eight cases of verrucous carcinoma of the oral cavity are presented. Radiation doses ranged from 5,000 to 7,000 rads x or γ radiation administered over a period of 5 to 7 weeks. Following radiation therapy immediate regression of the lesion was followed by a rapid anaplastic transformation of the histological pattern of the tumors. The possibility that irradiation may have induced the transformation of these low-grade malignant tumors into rapidly growing tumors is discussed. (C.H.)

18548 RADIOBIOLOGICAL RESEARCH WITH FAST NEUTRONS AND THE IMPLICATIONS FOR RADIOTHERAPY. Bewley, D. K. (Hammersmith Hospital, London). Radiology, 86: 251-7(Feb. 1966).

The physical and radiobiological properties of a fast neutron beam were investigated with radiotherapeutic applications in mind. The relative biological effectiveness (RBE) of fast neutrons is compared with that of x radiation, with emphasis on oxygen enhancement ratios and the effects of dose fractionation. Results of studies of cells in tissue culture, in pig and mouse skin, and intact mice indicate that variations of RBE between different tissues are not large but may be significant for therapy in certain cases. The therapeutic implications of the reduced oxygen ratio and reduced recovery using high LET radiation are discussed. (C.H.)

18549 FACTORS CONCERNED WITH CLINICAL RADIATION NAUSEA. Kurohara, Samuel S.; George III, Frederick W.; Levitt, Seymour; Rubin, Philip. Radiology, 86: 262-5(Feb. 1966).

Radiation sickness as applied in the management of patients with malignant disease refers to a symptom complex that includes nausea, vomiting, anorexia, nervousness, insomnia, malaise, fatigue, headache, dizziness, tachycardia, and sometimes other symptoms. The etiology of the disease has never been established. Results of an analysis of a double-blind study on the effect of two antiemetic drugs, Torecan and Diphenadol, on clinical radiation nausea, carried out in 235 patients, showed no significant differences in response from that obtained by placebos. The reason for this finding was ascribed to psychological factors. (C.H.)

18550 WHOLE-PELVIS IRRADIATION WITH 4,000 RADS IN STAGE I AND STAGE II CANCERS OF THE UTERINE CERVIX. Fletcher, Gilbert H.; Watanavit, Tongpoon; Rutledge, Felix N. (M. D. Anderson Hospital and Tumor Inst., Houston, Tex.). Radiology, 86: 436-43 (Mar. 1966).

Pelvic irradiation (3000 to 4000 rads) prior to radium therapy for cervical cancer is recommended for those cases not suited for primary intracavitary radium therapy. Complications from the external therapy may be minimized by careful control of the physical parameters of the irradiation technique. (H.G.D.)

18551 RADIOLOGICAL QUESTIONS ON PLASMOCYTOMA TREATMENT. Beyer, Winfried; Neumeister, Klaus (Karl-Marx-Univ., Leipzig). Strahlentherapie, 129: 182-8(Feb. 1966). (In German).

The literature concerning the origin, course and therapy of the plasmocytoma is reviewed, and a case is reported. The problems concerning radiosensitivity and radioinduced production of the plasmocytoma are discussed. Because of the generally dissatisfying therapeutic results obtained with procedures other than radiotherapy, it is suggested that x-ray therapy is always justified. (auth)

18552 ON FUNCTION TESTS OF BONE MARROW BEFORE AND AFTER RADIOTHERAPY OF MAMMARY AND GENITAL CARCINOMA OF THE FEMALE. Neutsch, Wolf-Dietrich; Schumann, Eberhard; Werner, Roland (Radiologische Klinik und Poliklinik der Medizinische Akademie, Erfurt, Ger.). Strahlentherapie, 129: 189-99(Feb. 1966). (In German).

The question of radiogenic damage of hematopoiesis by intensive irradiation therapy of breast and genital carcinomas was evaluated, using the pyrexal function test. The patterns of the leukocyte reaction were determined in 52 healthy controls. It is assumed that the decrease of leukocytes that is found in the peripheral blood following irradiation therapy in patients with carcinoma of the breast predominantly is an indirect effect on hematopoiesis, the bone marrow function remaining intact. Following treatment of genital carcinoma in the female, on the other hand, an additional effect on the hematopoietically active skeleton of the pelvis becomes apparent through a distinctly depressed bone-marrow function. (auth)

18553 EXPERIENCE WITH A NEW METHOD FOR DOSE PLANNING IN RADIATION THERAPY. EXACTNESS OF REPRODUCTION OF BODY CONTOURS. Setaelae, Kai; Nyyssoenen, Otto; Lindroos, Bjoern (Univ. of Helsinki). Strahlentherapie, 129: 207-19(Feb. 1966). (In German).

Applications of a new, laboratory-constructed device for dose planning and tumor localization in radiation therapy are presented. Both commercial average-man-equivalent phantoms, voluntary healthy control persons, and cancer patients were examined. The most important results were: turning from supine to prone, and vice

versa, of the lying patient provoked significant alterations in the outer patterns of the body-contour equivalents, in the length of the skin surface-irradiation target distance, and in the area of the transversal and sagittal cross sections. In the latter instance, a surplus or a deficit within the intended irradiation region developed; further a distinct declination between both 180°-body-contour equivalents became evident; in addition, a more or less high degree dislocation of the tumor area developed. All these phenomena indicate the fact that utilization of 180° + 180°-combination diagrams in the dose planning produces sources of error which are three-dimensional in nature. Only a directly obtained transversal 360°-body-contour equivalent in combination with an expedient sagittal one gives an unambiguous, true-to-nature image of the situation. (auth)

18554 RADIOACTIVE PHOSPHORUS (^{32}P) IN THE TREATMENT OF ERYTHREMIA (POLYCYTHEMIA VERA). Demidova, A. V. Terap. Arkh., 36: 113-16 (Oct. 1964). (In Russian).

This report described the results of treatment of 183 cases of polycythemia vera with ^{32}P over an observation period of several months to 12 years. No absolute criteria for the choice of the dose levels were used, consideration being given to the weight of the individual, age, severity of the disease, and the hematologic findings. Doses of 4 to 7 mC were given to elderly individuals, but in cases with marked splenomegaly, severe leucocytosis, and thrombocytosis a larger dose was required to obtain an effect. In the initial stages of the disease the doses were decreased to 3 to 5 mC especially in cases given combined treatment (^{32}P and phlebotomy) and cases of polycythemia in stages of myeloid metaplasia of the spleen. Such combined treatment was given in 30% of the observed cases. Complete hematologic remission of manifestations of the disease was attained after the first dose (2 to 10 mC) in 69.5% of the cases, incomplete hematologic remission in 19.5%, with no remission in 9.3% of the cases. Forty individuals received 1 to 3 additional courses of treatment with doses of ^{32}P ranging from 2 to 14 mC at intervals of from 3 to 6 months. Complete remission was then obtained in 85% of these cases, incomplete remission in 10.9%, and no effect in 2.18%, with three individuals dying during the first two months after treatment. In cases in which polycythemia was accompanied by other diseases (such as hypertension and diabetes) remission was achieved by repeated small doses. (TCO)

18555 PRECIS DE CURIETHERAPIE. ENDOCURIETHERAPIE—PLESIOCURIETHERAPIE. (Summary of Curietherapy. Endocurietherapy—Plesiocurietherapy). Pierquin, B. Paris, Masson and Cie, 1964. 353p.

Therapeutic applications of natural and artificial radioisotopes are described at the clinical level. Data on the physical properties, biological effects, and method of application of ^{226}Ra, ^{222}Rn, ^{60}Co, ^{182}Ta, ^{192}Ir, ^{198}Au, ^{32}P, ^{90}Sr, ^{90}Y, ^{131}I, ^{76}A, and some lesser-used radioisotopes are summarized. Clinical results of radioisotope therapy are discussed for various neoplasia. (C.H.)

CHEMISTRY

General

18556 (BNL-929, pp 66-82) CHEMISTRY. (Brookhaven National Lab., Upton, N. Y.).

Progress is reported in nuclear chemistry on high energy nuclear reactions, nuclear spectroscopy, solar neutrino experiments, meteorite studies, geochemistry, and investigations of archeological objects. Investigations in radiation chemistry, hot atom chemistry, molecular and crystal structure, isotope effects, and physical chemistry are reported. (J.R.D.)

18557 (ORNL-TM-1409) ELECTRON CAPTURE CROSS SECTIONS AND NEGATIVE ION LIFETIMES [Thesis]. Compton, R. N.; Hurst, G. S.; Christophorou, L. G.; Reinhardt, P. W. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 191p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Submitted by R. N. Compton to Univ. of Tennessee, Knoxville.

A method was developed which combined the electron swarm and electron beam techniques to obtain electron capture cross sections as a function of the electron energy. As examples of the method, electron capture cross sections were explicitly determined for chlorotoluene (peaking at ~1 ev) and oxygen (peaking at ~7 ev). The procedure proved to be a powerful method in determining both the magnitude of the attachment cross section and the electron energy scale. In the case of oxygen, good agreement with the data of total ionization experiments was found with respect to the magnitude and energy dependence of the cross section. The dissociative electron attachment cross section for H^- from water was determined. In addition, ion molecule reactions leading to OH^- were definitely attributed to the following processes: $H^- + H_2O \rightarrow OH^- + H_2$ and $O^- + H_2O \rightarrow OH^- + OH$. The swarm-beam method was also used to study electron attachment in a series of halogenated hydrocarbons. Certain correlations were observed to exist between the magnitude and position of the cross section and the type of halogen substituent. Dissociative attachment in iodobenzene leading to iodine negative ions was observed to peak at electron energies below kT. Non-dissociative electron attachment to complex molecules was investigated both experimentally and theoretically. Unimolecular electron attachment was observed in the following molecules: SF_6, $C_6H_5NO_2$, o-$C_6H_4CH_3NO_2$, m-$C_6H_4CH_3NO_2$, and $(CH_3CO)_2$. It was demonstrated that the parent negative ions thus formed are metastable. and the half lives against autodetachment for SF_6^{-*}, $C_6H_5NO_2^{-*}$, and $(CH_3CO)_2^{-*}$ were determined to be 25, 40 and 12 microseconds, respectively. A theoretical study of long-lived negative ions was presented which treated the molecule as a system of harmonic oscillators. Specifically, the negative ion lifetime was related to the electron capture cross section by the principle of detail balance. The attachment cross section was assumed to be the maximum possible (i.e., $\pi\lambda^2$). The theory successfully accounted for the measured lifetime of the SF_6^{-*} ions. The possibility of combining electron capture cross sections and negative ion lifetime measurements to determine electron affinities was pointed out. As an example, the electron affinity of $(CH_3CO)_2$ was calculated to be ~1.1 ev. 88 references. (auth)

Analytical Procedures

See also Separation Processes and Procedures

Refer also to abstracts 18633 and 18910.

18558 (AECL-2526) X-RAY SPECTROGRAPHIC DETERMINATION OF SOME METAL OXIDE ADDITIVES IN UO_2 AND ThO_2. Wray, L. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1965. 10p. (CRDC-1230). Dep. mn. AECL $0.50.

Methods of analysis are described for La, Nb, Th, Ti, and Zr additives in UO_2, and for U and Y additives in ThO_2, present in the concentration range 0.05-1.0%. Th, Y, or Zr in UO_2, and U or Y in ThO_2 were determined directly in the oxide mixture. A suitable analytical line of the matrix element was used as an internal standard. Limits of detection were between 0.006 and 0.01% for these additives. For La, Ti, or Nb in UO_2, the oxide was dissolved in HNO_3 and the uranium removed by organic solvent extraction. La and Ti were determined in aqueous solution. The limit of detection was about 0.002%. Nb was precipitated in the presence of cellulose and briquetted. The limit of detection was 0.0005%. (auth)

18559 (CALT-221-14) RAMAN SCATTERING IN X-RAYS. Das Gupta, K. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Feb. 1966. Contract AT(04-3)-221. 8p. (CONF-650657-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From International Conference on Physics of X-Ray Spectra, Ithaca, N. Y.

Modified Raman lines due to carbon in oxalic acid, anthracene, and naphthalene were observed. A high light gathering power bent crystal spectrograph of radius 14 cm was used at a scattering angle of 30° using copper Kα radiation filtered through a nickel foil to remove copper Kβ. A discussion and summary of results are presented. (M.O.W.)

18560 (EUR-2454.f) DETERMINATION DE LA COMPOSITION, JUSQU'AUX HEXAPHENYLES INCLUS, DE POLYPHENYLES AYANT SUBI LA PYROLYSE ET/OU LA RADIOLYSE. (Determination of the Composition, up to and Including Hexaphenyls, of Polyphenyls which have been Subjected to Pyrolysis and/or Radiolysis). Aurenge, J.; Houllier, A.; Lombre, R.; Normand, J.; Steinmuller, R.; Trillet, J.; Tron, F. (Societe Progil, Lyon (France). Laboratoire Central de Recherches). 1965. 82p. Dep. mn.

Results obtained in the field of polyphenyl analysis are reported. The studies carried out were aimed at improving knowledge of the composition of pyrolyzed polyphenyls and related to: development of separation techniques, such as: molecular vacuum distillation, liquid-phase column chromatography, and gaseous-phase preparatory chromatography; and improvement of gas-phase chromatography in the sense of an increase in the effectiveness of the organic stationary-phase columns, utilization of high-temperature columns by the use of mineral stationary phases, and study and utilization of various detectors. In this connection, special operations were carried out in connection with: overall analysis of the pyrolytic or radiolytic heavy products, determination of terphenyl in nitrogen of pressurization, determination of benzol in radiolyzed terphenyl, preparation of tetraphenyls by fractional crystallization in suitable solvents, and use of a preparatory chromatograph. Bibliographical work was performed in connection with certain physical and spectral data on polyphenyls. (auth)

18561 (EUR-2635.d) MESSUNG DER VERTEILUNGSKOEFFIZIENTEN VON AKTINIDEN UND LANTHANIDEN ZWISCHEN WAESSRIGER SALPETERSAEUR UND LOESUNGEN VON TRI-n-OKTYLPHOSPHINOXID (TOPO) UND TRILAURYLAMIN (TLA) IN DIAETHYLBENZOL SYNERGISTISCHE EFFEKTE. (Measurement of the Distribution Coefficient of Actinides and Lanthanides Between Aqueous Nitric Acid and Solutions of Tri-n-Octylphosphine Oxide (TOPO) and Trilaurylamine (TLA) in Diethylbenzene; Synergistic Effects). Ihle, H.; Michael, H.; Murrenhoff, A. (Kernforschungsanlage, Juelich (West Germany)). Jan. 1966. 18p. (CONF-650966-1). Dep. mn.

From Meeting of the German Chemical Society and "Kekule-Festival," Bonn, Germany.

Coefficients for the distribution of Pu^{4+}, Am^{3+}, Cm^{3+}, and Pm^{3+} between aqueous nitric acid and organic solutions of

TOPO and TLA in diethylbenzene were measured as a function of the nitric acid and lithium nitrate concentration in the aqueous phase, the TOPO and TLA concentration in the organic phase, and the TOPO/TLA ratio in the organic phase. When a mixture of TOPO and TLA was used, the distribution coefficient was influenced by a synergistic effect. For the trivalent ions in the lithium nitrate-containing system, the synergistic coefficient was greatest when the TOPO/TLA ratio in the organic phase was 1 : 10 to 1 : 100. The Am/Cm separation factor measured for TLA solutions without an admixture of TOPO was only slightly reduced by this small addition of TOPO, whereas the distribution coefficients could be substantially increased thereby. Without the addition of lithium nitrate to the aqueous phase, a negative synergistic coefficient was found in the measured range for the four ions investigated. (auth)

18562 (EUR–2640.e) TRANSPLUTONIDE RESEARCH. Final Report. van Dalen, A.; Kraak, W.; van Ooyen, J.; Polak, P.; Post, J. C. (Reactor Centrum Nederland, Petten). Nov. 8, 1965. 64p. Dep. mn.

The extraction of americium and rare earth elements from a 5M magnesium chloride solution into tertiary amine hydrochloride solution in xylene gave a separation factor of 100 between actinides and lanthanides. When nitrate ion was added to the aqueous phase to increase americium extraction, the separation factor decreased considerably. Paper electrophoresis in a complexing electrolyte medium was investigated as a method for the separation of americium, curium and rare earth elements. Results are reported with alpha-hydroxy isobutyric acid and ethylenediaminetetraacetate as complexing agents. Anion exchange separations of americium and curium were accomplished in column elution experiments with aluminum nitrate and magnesium nitrate solutions as eluants. Separation factors of 1.8 were obtained. The problems of low efficiency counting were investigated with respect to the calibration of alpha-emitters. A counting device for soft gamma and Röntgen radiation was constructed and tested. An alpha spectrometer based on the principle of a semiconductor is described as developed for the purpose of determining isotopic compositions of alpha emitting nuclides. Various techniques for preparing thin and thick layers of uranium, neptunium, plutonium, americium, and curium were investigated. These layers are to be used as targets for irradiations in a cyclotron. However, under certain circumstances they may also be useful for reactor irradiations. (auth)

18563 (EUR–2647.f) CONTRIBUTION A L'ETUDE DU DOSAGE SPECTROGRAPHIQUE DES IMPURETES DANS L'URANIUM PAR LA METHODE DE DISTILLATION AVEC ENTRAINEUR. (Spectrographic Determination of Uranium Impurities by Carrier Distillation). Ceccarelli, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 1966. 18p. Dep. mn.

Impurities were detected in uranium by a modified carrier distillation method. The essential modification consists in a longer exposure time (100 sec.). This permits the distillation curve for all elements to be obtained by vertical displacement of the plate each 25 seconds, with a remarkable improvement of the precision and the reproductibility. The upper limits of concentration given by the classic method are lowered. The application of the working procedure to the other refractory compounds could eliminate their matrix effects. (auth)

18564 (EUR–2748.e) KINETIC STUDIES OF THE EXCHANGE ADSORPTION OF IONS FROM ACID SOLUTIONS ON AN INORGANIC ION EXCHANGER. Van Deyck, D.; Baetsle, L. H. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Dec. 15, 1965. 28p. Dep. mn.

After a short review of the main diffusion mechanisms occurring during ion exchange reactions a thorough analysis was made of the parameters that influence the rate of attainment of equilibrium on a new inorganic ion exchanger ferrocyanide molybdate. Shallow bed runs at different flow velocity and particle size point at the fact that the overall time to reach equilibrium is divided into two parts, one to be ascribed to film diffusion and the balance to particle diffusion. From the net contributions of both mechanisms the apparent diffusion coefficients were calculated showing a difference of two to three orders of magnitude between the diffusion in the film surrounding the particles and in the solid phase. Since the variability of the overall time to reach equilibrium was found to depend on the distribution coefficients another relation is proposed for deriving the film diffusion coefficients. The variability observed in the particle diffusion constants of ferrocyanide molybdate on standing time in acid solution was ascribed to a degree swelling of the matrix. No explanation could be found for the discrepancy between the experimental column capacity parameters and those derived from theoretical considerations. (P.C.H.)

18565 (LA–3465) SEPARATION AND SPECTROPHOTOMETRIC MEASUREMENT OF LOW CONCENTRATIONS OF TANTALUM. Waterbury, G. R.; Thorn, L. E.; Kelly, R. C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Feb. 1, 1966. Contract W-7405-eng-36. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The spectrophotometric method for determining 25 to 100 μg of tantalum in uranium or plutonium alloys was modified to apply to the measurement of 5 ppM or greater of tantalum. The main changes were an increase in sample size to a maximum of 5 grams and a preliminary separation of the tantalum by extraction from a 6 M hydrochloric–0.8 M hydrofluoric acid solution of the sample into hexone. A major part of the selectivity of the method depend upon a second extraction of the tantalum from 6 M sulfuric–0.4 M hydrofluoric acid solution into hexone to effect separation from metals coextracted from the hydrochloric–hydrofluoric acid solution. The spectrophotometric measurement is based upon a color formed by tantalum with hydroquinone in 18 M sulfuric acid. The molar absorptivity of the tantalum-hydroquinone compound was 3650 at a wavelength of 375 mμ. An average for the tantalum found of 99% and relative standard deviations of 13 and 11% were obtained for 32 analyses of solutions containing 4.80 grams of plutonium and either 25 or 50 μg (5 or 10 ppM) of tantalum. An average for the tantalum found of 100% and relative standard deviations of 5.0, 2.0, and 1.3% were obtained for 42 analyses of solutions containing 1 gram of plutonium and 50, 100, and 500 μg (50, 100, and 500 ppM) of tantalum, respectively. Titanium, molybdenum, and niobium cause interference in this method. (auth)

18566 (LA–3469) SPECTROPHOTOMETRIC DETERMINATION OF MICROGRAM AMOUNTS OF THORIUM IN PLUTONIUM. Nelson, G. B.; Waterbury, G. R.; Baughman, W. J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Jan. 17, 1966. Contract W-7405-eng-36. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Thorium when present in the concentration range of 15 to 140 ppM in plutonium-containing materials is measured spectrophotometrically as the thorium-thorin complex. This measurement is made following separation of thorium by precipitation as thorium fluoride, with lanthanum fluoride carrier, while plutonium is oxidized to the fluoride-soluble (VI) oxidation state. The molar absorptivity of the thorium-thorin complex is 15,600 at 545 mμ. The relative standard deviations in determining 5 and 17 μg (10 and 34 ppM) of thorium are 11 and 4%, respectively. In the range of 33 to 73 μg (66 to 146 ppM) of thorium, the relative standard deviation is not greater than 1.8%. The average for the thorium found in 91 determinations of 5 to 73 μg of thorium was 99 ± 1%. (auth)

18567 (MAB–217-M) COOPERATIVE ANALYSIS PROGRAM ON REFRACTORY METAL ALLOYS. (Materials Advisory Board, National Academy of Sciences–National Research Council, Washington, D. C.). Feb. 1966. 44p. CFSTI.

Unalloyed W, T-111, FS-85, and TZM alloys were prepared and analyzed by 25 cooperating laboratories. No serious problems were encountered in determining alloying elements. Hydrogen and carbon determinations could be made satisfactorily at the levels encountered, but agreement on oxygen was not satisfactory below the 10 ppM level. Recom-

mendations for research to solve remaining problems are offered. (auth)

18568 (NBL–230) ANNUAL PROGRESS REPORT FOR THE PERIOD JULY 1964 THROUGH JUNE 1965. (New Brunswick Lab. (AEC), N. J.). Dec. 1965. 85p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Analyzed samples of elemental B for impurity determinations are being prepared. The B-10 radioactive scrap recovery program was reactivated. The evaluation of the methods in TID-7029 is nearing completion. A direct method of spectrochemical analysis of impurities in B is described. A method for determining U and Pu by isotope dilution analysis involving alpha spectrometry with a semiconductor detector is described. A method for the determination of F in the presence of relatively large amounts of O by fast neutron activation was developed. The method for the determination of 10B by thermal neutron absorption using neutrons from Ra–Be sources was modified by the use of Pu–Be sources. Methods for the determination of impurities in elemental B by fast neutron activation (14 Mev) using a Cockcroft-Walton accelerator are being developed and evaluated. A revision of a flip-flop source filament loading assembly is described. Changes made in mass spectrometers and procedures used for analyses of B materials to determine more reproducible ratios are summarized. Modifications were made in mass spectrometers used for the isotopic analyses of U. A method for the ion-exchange separation and gravimetric determination of sulfate sulfur in thorium nitrate is presented. Methods for determination of B in Al–B mixtures are presented. A method for analysis of micro- and milligram quantities of U in press cakes and other scrap materials is presented. An isotopically homogeneous lot of about 250 g. of plutonium sulfate tetrahydrate was prepared for an isotopic Pu standard. The use of ThO_2 and ThO_2–UO_2 in preparation of analytical working curve standards for determination of B in ThO_2(96%)–$^{233}UO_2$(4%) samples was compared. A commercial automatic titrator was modified for use in determining Pu with potassium dichromate. Data are given to compare results using Cr-target x-ray tubes with those obtained with W-target tubes. Standard specifications for a carrier-distillation type anode cap electrode are presented. (J.R.D.)

18569 (NP–15887) DOSAGE DU SOUFRE ET DU PHOSPHORE PAR RADIOACTIVATION [Theses]. (Determination of Sulfur and Phosphorus by Radioactivation [Thesis]). Chomel, Noelle (Lyon Univ. (France)). [1964]. 42p. Dep. mn.

Two radiochemical methods for the determination of sulfur and phosphorus in a mixture were investigated. Irradiation by reactor neutrons in determinations by the nuclides ^{35}S and ^{32}P was found to be the most frequent and most sensitive method. At a flux of 10^{12} n/cm^2/sec and a counting rate of 60 cpm, the sensitivity was established at 34 and 8 μg of sulfur and phosphorus for irradiations of 6 min and at 10 and 10^{-2} μm for irradiations of a month. However such an analysis has multiple difficulties because of the delicate and laborious chemical separations necessary and from possible interferences necessitating a double radiation. The length of analysis is very long. Its use is imposed then only for the study of very small quantities. However, in the case of samples where it is necessary to destroy them or where concentrations of sulfur and phosphorus are small, irradiation with 14-Mev neutrons appeared promising. The sensitivity limits were established at 1 mg of sulfur and 10 μg of phosphorus. (P.C.H.)

18570 (NYO–2757-5) DEVELOPMENT OF ^{85}Kr AS A UNIVERSAL TRACER. EXTENSION OF PHASE III. AREAS OF APPLICATION. Period Covered: November 1, 1963–October 31, 1964. Chleck, David; Maehl, Richard; Cucchiara, Orlando (Parametrics, Inc., Waltham, Mass.). Feb. 1966. Contract AT(30-1)-2757. 64p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The direct application of kryptonates to a number of important problem areas was further substantiated and/or explored. Methods for preparing kryptonates were extended. Homogeneous kryptonation, i.e., uniform kryptonation in depth, was achieved by varying the kryptonation conditions. By noting the point of activity release on reheating a temperature stabilized sample, the maximum surface temperatures attained by various kryptonated solids were measured. The accuracy was found to be limited only by the independent temperature measurement, (thermocouples) at temperatures up to about 2000°F. The use of kryptonates to determine trace water in organic liquids was developed further. The feasibility of a method for aqueous sulfate ion analysis via release of krypton-85 from kryptonated barium carbonate in a saturated barium carbonate solution was demonstrated. Krypton-85 release from kryptonated wires subjected to tensile stress in both air and inert atmosphere provided evidence of oxidation during the creep of these materials. The detection of corrosion in aqueous salt solution via loss in activity of kryptonated aluminum was demonstrated as was a means of testing a corrosive resistant coating (paint) by krypton-85 release from a kryptonated substrate (iron) under controlled environment. (auth)

18571 (ORNL-TM-1420) THE BIS-(β-CHLOROETHYL) ETHER EXTRACTION OF IRON(III) FROM HYDROCHLORIC ACID SOLUTIONS AND THE EFFECT OF AN INERT DILUENT ON THE DISTRIBUTION COEFFICIENT. Pinajian, J. J. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The bis-(β-chloroethyl)ether extraction of iron(III) from hydrochloric acid solutions was investigated as a function of the iron and hydrochloric acid concentrations. Values of the K_D are given for 0.01- .... 500 mM Fe^{3+} and 2- .... 12 M HCl. The K_D was found to increase with an increase in hydrochloric acid concentration and a decrease in iron concentration. The extraction of 0.01 mM $^{59}Fe^{3+}$ from bis-(β-chloroethyl)ether–hexane solutions into 12 M HCl was measured as a function of the concentration of hexane. The K_D was found to fall from 960 at zero n-hexane concentration to 4.8×10^{-2} at 6 M n-hexane. The distribution coefficients of carrier-free ^{7}Be, ^{54}Mn, and ^{88}Y are given for the bis-(β-chloroethyl)ether/10 M HCl system and their factors for separation from iron estimated. (auth)

18572 (PG-Report-690) ANALYTICAL METHOD FOR THE DETERMINATION OF ACETONE AND METHYL ETHYL KETONE IN AQUEOUS SOLUTIONS (GAS CHROMATOGRAPHY). (Production Group, United Kingdom Atomic Energy Authority, Sellafield (England)). 1966. 5p. Dep. BIS $0.25. HMSO 1s. 2d.

A method is described for the determination of acetone and methyl ethyl ketone in aqueous solutions. A known weight of 1,4-dioxane is added to the sample. The mixture is chromatographed on a Celite column containing 10% of polyethylene glycol 400 at a temperature of 100°C. The peak height ratio of dioxane to acetone and dioxane to methyl ethyl ketone is then used to obtain the concentration of each ketone in the sample. Precision (3σ) was judged to be ±15% at the 1% level of ketone in water, with an accuracy not greater than 2% at the 1% concentration level. The limit of detection is approximately 0.005%. (P.C.H.)

18573 (RISO–120) A BRIDGE FOR CONCENTRATION MEASUREMENT. Diamond, J. M. (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Nov. 1965. 38p. Dep. mn.

An a-c bridge system for concentration measurement is described. With 1 microwatt in the thermistors, a resistance change of 0.4 ppm is detectable, corresponding to a temperature change of 12 microdegrees or a mole fraction of 0.7 (10^{-6}). The advantages of the a-c bridge are discussed. The possibilities of linearizing the relation between bridge reading and temperature, between bridge reading and reciprocal temperature and between bridge reading and concentration are considered. The practical design of the bridge and auxiliary equipment is discussed. (auth)

18574 (TID–7015(Suppl.8)) OAK RIDGE NATIONAL LABORATORY MASTER ANALYTICAL MANUAL. Supplement 8. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 338p. Dep. CFSTI $4.00 cy, $1.50 mn.

Fourteen new methods to be added to the ORNL Master Analytical Manual and 23 revisions to previously issued methods are included. The methods covered include: ionic; process; radiochemical; and nuclear analysis methods. (P.C.H.)

18575 (TID-7015(Indexes)(Rev.3)) INDEXES TO THE OAK RIDGE NATIONAL LABORATORY MASTER ANALYTICAL MANUAL (1953–1965). Raaen, Helen P.; Haas, Ann Klein (eds.) (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 164p. Dep. mn. CFSTI $1.75 cy, $1.00 mn.

Information on the ORNL Master Analytical Manual, which is a collection of the analytical methods developed and used in the ORNL Analytical Chemistry Division, is presented. Included are a key word index composed from method titles a bibliographic index that is equivalent to a table of contents of the Manual, an author index, and method-number cross indexes. The bibliographic index gives the complete history and current status of each method. The references given cover the period 1953 through 1965. (P.C.H.)

18576 (TID-22660) THE CHEMISTRY AND ANALYSIS OF TRACE METALS IN SEA WATER. Progress Report No. 2, August 1, 1961–November 1, 1962. Slowey, J. Frank; Hedges, Dorthea; Hood, Donald W. (Texas Agricultural and Mechanical Coll., College Station. Dept. of Oceanography and Meteorology). Oct. 31, 1962. Contract AT(40-1)-2799. 70p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A method for trace metal analysis by activation analysis was developed and placed in operation. Reactor facilities giving a radiation level of about 1×10^{11} thermal neutrons/second were also placed in operation and are used as a very satisfactory radiation source. A laboratory with low level contamination was completed. Chemical techniques were carefully examined using isotopic tracers ^{54}Mn, ^{64}Cu, and ^{65}Zn and found to be highly reproducible and giving yields of approximately 100% when applied to laboratory samples. Similar results were also obtained for Mn and Zn in seawater samples but the coprecipitation technique applied to Cu gave very low yield and proved to be unsatisfactory. Results of a careful analysis of a station in the Pacific for ionic (divalent) Mn, Cu, and Zn are reported. Continuing work on the Swordfish Program revealed that most of the ^{95}Zr, ^{103}Ru, and $^{141-144}Ce$ remained in the dissolved state in seawater as long as 7 weeks after addition to the ocean. The maximum activity was found between 100 and 150 ft. The data emphasize the extreme importance of a better understanding of the distribution and chemistry of these elements in seawater. (83 references). (P.C.H.)

18577 (TID-22670) THE DETERMINATION OF URANIUM AND THORIUM METAL IN FUEL ELEMENT CORE MATERIALS. Hibbits, James O.; Schaefer, E. Allen (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). June 1965. Contract AT(40-1)-2849. 26p. (GE-TM-65-9-14). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Uranium and/or thorium metal were determined in sintered UO_2, ThO_2, UO_2-ThO_2, and $W-UO_2$ specimens. The method of determination involves the formation of the metal hydrides UH_3 and Th_4H_{15}, and their selective decomposition. At 325°C, UH_3 decomposes to U and H_2 and Th_4H_{15} decomposes to ThH_2 and H_2. At 600°C, ThH_2 decomposes to Th and H_2. The hydrogen released by decomposition is determined by gas chromatography. The accuracy of the determination is limited by the location of the metallic phase(s) present. In general, metal located along a grain boundary will react with hydrogen and subsequently be determined, whereas metal located within a grain will probably not hydride, and thus will escape subsequent detection. The method is not applicable to $Mo-UO_2$ specimens because of the solubility of uranium metal in molybdenum. A high molybdenum-low uranium alloy does not hydride to any appreciable extent under the conditions outlined in this paper. (auth)

18578 (TRG-Report-1165) DETERMINATION OF PLUTONIUM AND URANIUM IN CERAMIC FUEL SAMPLES. Sinclair, V. M.; Davies, W.; Drummond, J. L. (Reactor Group, United Kingdom Atomic Energy Authority, Dounreay (Scotland)). Jan. 5, 1966. 14p. (CONF-651004-11). Dep. BIS $0.50. HMSO 2s. 6d.

From 9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn.

Three methods are described for the determination of plutonium and uranium in ceramic fuel samples. Separate volumetric methods are described for the two elements, as currently used on a routine basis at D.E.R.E. Next a constant-current potential-limit coulometric technique is described. It was developed for the successive determination of plutonium and uranium at a platinum cathode. An X-ray fluorescence method is also described for the concentration ratio of the two elements. It is of particular use for process control analysis. The performances and relative merits of the three approaches are compared. (auth)

18579 (UJV-1489) ISOLATION OF TRACE AMOUNTS OF STRONTIUM BY THE COPRECIPITATION WITH BARIUM SULFATE. Kyrs, M.; Konecny, C.; Kadlecova, L. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1966. 11p. Dep. mn.

The coprecipitation of strontium with barium sulfate was investigated in dependence on the order of reagent addition, rate of precipitation, and amount of barium sulfate precipitate. The removal of strontium was found to be optimum (99%) when the total amount of sulfate ions was first added to the raw water and afterwards, the barium nitrate solution was added in small portions. Based on the results obtained, the mechanism of strontium coprecipitation is discussed. (auth)

18580 (USNRDL-TR-934) ANALYSIS OF $^{134}Cs-^{137}Cs$ MIXTURES BY GAMMA-RAY SPECTROMETRIC METHODS. Yamamoto, S. (Naval Radiological Defense Lab., San Francisco, Calif.). Jan. 9, 1966. Contract AT(49-2)-1167). 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The sensitivity and accuracy of two analytical methods, gamma-gamma coincidence spectrometry and least-squares analysis of non-coincident gamma-ray spectra, were evaluated for the analysis of $^{134}Cs-^{137}Cs$ mixtures. Gamma-gamma coincidence spectrometry was found to be a highly sensitive method for analyzing $^{134}Cs-^{137}Cs$ mixtures. By this method ^{134}Cs can be accurately determined in mixtures where the $^{134}Cs/^{137}Cs$ count-rate ratio is as low as 0.002. While least-squares analysis of non-coincident gamma spectra was found to be more sensitive than other non-coincidence methods, it could not determine ^{134}Cs in mixtures with count-rate ratios below 0.01. (auth)

18581 DETERMINATION OF AMERICIUM AND RARE EARTHS BY GRAVIMETRIC MICROANALYSIS. Clanet, Frank; Pages, Monique (Institut du Radium, Paris). Anal. Chim. Acta, 34: 367-9(Mar. 1966). (In French).

A gravimetric microanalytical method for americium(III) was developed based on the precipitation of one of its oxalates. The precipitation is made on a porous support of filter paper impregnated with oxalic acid which behaves as a solid reagent. Under these conditions the precipitation and filtration take place simultaneously at the point of application. The oxalates were precipitated from acid solutions, and the details of the experimental conditions are given. The results of the microgravimetric analysis were compared with the results obtained from spectrophotometry and measurement of the γ radiation. The 3 series of results are in good agreement. The method was generalized for the determination of europium, and equally good results were obtained. (J.S.R.)

18582 BORON DETERMINATION IN SILICON AND GERMANIUM BY ACTIVATION WITH PROTONS AND DEUTERONS. Rommel, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Anal. Chim. Acta, 34: 427-46(Apr. 1966). (In German).

Determination of boron via the nuclear reaction $^{11}B(p,n)^{11}C$ was studied in detail; the nitrogen reaction $^{14}N(p,\alpha)^{11}C$ interferes. Nitrogen also interferes in deuteron activation via the nuclear reactions $^{10}B(d,n)^{11}C$ and $^{11}B(d,2n)^{11}C$; this interference must be attributed to the nuclear reaction $^{14}N(d,\alpha n)^{11}C$. Both interferences were investigated quanti-

tatively. The conditions for accurate determination of boron and for a simultaneous determination of boron and nitrogen by proton activation were established. An analytical method with chemical separation of the radioisotope ^{11}C was developed for silicon and germanium. (auth)

18583 THE SZILARD-CHALMERS EFFECT APPLIED IN THE NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL SAMPLES. Brune, Dag (AB Atomenergi, Studsvik, Sweden). Anal. Chim. Acta, 34: 447-55(Apr. 1966).

The Szilard-Chalmers effect was applied in the separation of activities, originating from organically bound elements, from neutron-irradiated material. The nuclides ^{76}As, ^{198}Au, ^{82}Br, ^{47}Ca, ^{115}Cd, ^{38}Cl, ^{60}Co, ^{51}Cr, ^{134}Cs, ^{64}Cu, ^{59}Fe, ^{27}Mg, ^{99}Mo, ^{24}Na, ^{32}P, ^{86}Rb, ^{75}Se, and ^{65}Zn were extracted from liver tissue, whole blood, or muscle tissue with water or with varying strengths of hydrochloric acid. The recoveries of the alkali metal nuclides, ^{82}Br and ^{38}Cl, in the water and hydrochloric extracts were ≥95%. In the concentrated hydrochloric acid extracts, the recovery of most nuclides exceeded 90%. The enrichment of the different nuclides obtained in the Szilard-Chalmers process was investigated by reactivation of part of the extracts. The effect of dilution, which favors the yield, was investigated in the separation of ^{59}Fe from whole blood samples. (auth)

18584 IDENTIFICATION OF RADIONUCLIDES BY SEMIQUANTITATIVE AUTORADIOGRAPHIC DETERMINATION OF HALF-LIFE BY THE RING-OVEN METHOD. Weisz, H.; Klockow, D. (Univ., Freiburg i. B.). Anal. Chim. Acta, 34: 456-64(Apr. 1966). (In German).

In the proposed method, 9 rings are prepared from different μl-volumes of a solution of the radionuclide under test (specific activity 1.5 to 2.5 μC/μl). At a starting time t = 0 and at 3 later times, each series of rings is placed on x-ray film strips for a period of 1 hr. After the usual development of the 4 strips, 4 density scales are obtained corresponding to 4 different times, and these can be compared by the method of weighted means. From the decrease in density of the rings, the half life of the radionuclide can be estimated. The method is explained for the examples ^{198}Au, $^{99}Mo/^{99m}Tc$, ^{153}Sm, and ^{131}I. (auth)

18585 QUALITATIVE AND QUANTITATIVE ANALYSIS OF RARE EARTH MIXTURES BY MEANS OF MAGNETO-OPTICAL ROTATION. Briat, B. (EPCI, Paris); Billardon, M.; Badoz, J.; Loriers, J. Anal. Chim. Acta, 34: 465-82(Apr. 1966). (In French).

The general features of a physical process for the qualitative and quantitative routine analysis of rare earth mixtures are given. The characteristic sharp lines in the magneto-optical rotation spectra of these elements are utilized. The recording photoelectric spectropolarimeter used is described. A comparison was made with two other physical processes, absorption and x-ray fluorescence spectrometry. The proposed method appeared to be best when a mixture with more than 3 or 4 elements must be analyzed. The sensitivity and accuracy are given for 9 rare earths. Improvements of the process are suggested. (auth)

18586 N-BENZOYL-N-PHENYLHYDROXYLAMINE AS A REAGENT FOR THE SEPARATION OF ^{95}Nb FROM ^{95}Zr AND FOR THE SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM AND NIOBIUM. Shigematsu, Tsunenobu; Nishikawa, Yasuharu; Goda, Shiro; Hirayama, Hiroshi. Bull. Inst. Chem. Res., Kyoto Univ., 43: 347-54(Sept. 1965).

The solvent extraction and the spectrophotometric determination of Zr and Nb were investigated using N-benzoyl-N-phenylhydroxylamine (NBPHA) as a chelating reagent. With 0.1% NBPHA in $CHCl_3$, more than 98% of Zr was extracted from 0.05 to 0.1N H_2SO_4 solution and 95% or more of Nb was extracted from 12 to 15N H_2SO_4 solution. Since Zr is completely left in aqueous phase under the optimum extracting condition for Nb, the extraction procedure can be applied to the separation of ^{95}Nb from ^{95}Zr. Zirconium and Nb chelates extracted showed light absorption in ultraviolet and near ultraviolet region, and therefore the procedure can also be adapted for the photometric determination of these metal ions. When absorbances are obtained at 350 mμ or 360 mμ, Beer's law is followed up to 20 ppM of both ions, and the molar extinction coefficients of Zr are 5,200 at 350 mμ and 2,950 at 360 mμ; and those of Nb are 4,250 at 350 mμ and 3,050 at 360 mμ, respectively. (auth)

18587 ESTIMATION OF THE CHIEF COMPONENTS OF A TIN AND ANTIMONY SOLDER BY MEANS OF BETA RADIATION BACK SCATTERING. Krivan, Viliam (Katedra Radiochemie a Radiacnej Chemie Chemickej Faculty, Bratislava). Chem. Prumysl, 15: 39-41(1965). (In Czech).

A simple method for analysis of Sn, Sb, and Pb in Sb-Sn solders was developed using β radiation back scattering. An annular source of radiation based on a ^{204}Tl source is outlined and illustrated; a Geiger-Muelier counter was used as detector. Calibration curves for the intensity of radiation from Pb relative to that from Sn as a function of density of the absorption filter, a linear calibration of intensity of radiation with respect to percent Pb between 0 and 70%, and a linear calibration between radiation intensity and % Sb between 0 and 12% are given. Data from comparison with chemical analysis are tabulated. For Pb between 7 and 80%, the relative error of the new method is between 1 and 7% (standard deviation 2.3%); for Sb between 0.5 and 14%, relative error was more than 10% at low concentrations, but less than 10% at concentrations greater than 5%. The method is not destructive, and it is unnecessary to dissolve samples. (BBB)

18588 AMPEROMETRY WITH TWO POLARIZABLE ELECTRODES. IV. DIRECT CHELOMETRIC DETERMINATION OF THORIUM. Vydra, F.; Vorlicek, J. (Inst. of Polarography, Prague). Collect. Czech. Chem. Commun., 31: 51-7(Jan. 1966).

The electrode systems Pt–Pt and C–C were used for biamperometric indication of a direct chelometric determination of Th. Influence of pH, the applied voltage, and a number of ions on the accuracy of the determination were studied. (auth)

18589 TEMPERATURE DEPENDENCE OF COEFFICIENTS OF SEPARATION OF ISOTOPIC MOLECULES D_2–H_2, D_2–HD AND HD–H_2 ON SYNTHETIC ZEOLITES NaA AND NaX IN THE CASE OF SORPTION UNDER ISOBARIC CONDITIONS. Parabuzin, V. S.; Panchenkov, G. M. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 164: 856-9(Oct. 1, 1965). (In Russian).

Following up previous studies on the separation of hydrogen isotopes adsorbed on mixed, Na–Co type cation exchange zeolites, the temperature dependence of the separation coefficients of the D_2–H_2, D_2–HD and HD–H_2 isotope pairs during the sorption of the 3-component system on the granulated, industrial synthetic zeolites, designated as NaA and NaX was investigated. It was found that at the experimental temperatures of 90.4, 77.6, and 62°K the coefficients are not markedly affected by pressure changes within the 200 to 400 mm of Hg range; the tests were carried out at 300 mm, cooling the system with liquid oxygen and hydrogen. The separation coefficients were calculated from the formula $\alpha = R_{zeol.}/R_{gas}$ whereby $R_{zeol.}$ and R_{gas} designate the concentration ratio of the heavy and light components in the adsorbed and gaseous phases, respectively. The isotopic concentrations in the gas phase were determined spectrographically while the concentration on the zeolite was calculated from the material balance equation. The separation coefficients obtained with both zeolites agreed with results of previous studies; the somewhat higher values were attributed to differences in the resins and techniques used. The temperature dependence may be expressed by $\log \alpha = A + B/T$, where α is the ratio of the heavy and light isotopes, A and B are constants related to the equilibrium constant and T is the absolute temperature. The entropy ΔS^0 and enthalpy ΔH^0 values of the van't Hoff equations were also determined. The data indicate that it might be possible to enrich deuterium by adsorption on synthetic zeolites. (TTT)

18590 ISOTOPIC ANALYSIS OF HEAVY WATER BY INFRARED SPECTROMETRY. Rojas, Jose L. Energ. Nucl. (Madrid), 9: 453-8(Nov.-Dec. 1965). (In Spanish).

The utility of infrared spectrometry in the isotopic analysis of heavy water was investigated. The analytical techniques used for determination of heavy water by infrared spectrometry are described. The techniques can be used during the handling of heavy water and in electrolysis and rectification installations for the production of D_2O. (J.S.R.)

18591 APPLICATION OF ATOMIC ABSORPTION ANALYSIS IN NUCLEAR ENERGY. Normand, Mme. Energ. Nucl. (Madrid), 9: 461-9(Nov.-Dec. 1965). (In Spanish).

The use of atomic absorption as an analytical technique is considered by giving examples in which the results obtained are compared with other methods. Atomic absorption is compared with the precision of flame spectrometry, absorption spectrometry, and emission spectrometry. The utility of the method in the analysis of complex mixtures such as fission product mixtures is considered. (J.S.R.)

18592 DETERMINATION OF ^{90}Sr AND ^{137}Cs IN SEA WATER SAMPLED SIMULTANEOUSLY FROM SEVERAL BODIES OF WATER FACING THE PROVINCE OF GENOA. Orlando, Giorgio; Riva, Valerio (Univ. of Genoa). Giorn. Ig. Med. Prevent., 6: 73-7(Jan.-Mar. 1965). (In Italian).

A technique for the separation of ^{90}Sr from 100 liters of sea water, preparation of the sample for analysis, and a technique for determination of ^{137}Cs from 1 liter of sea water are outlined; a Geiger-Mueller counter was used for counting. Data for samples taken from seven locations in the province of Genoa are reported for ^{137}Cs in pC/l, ^{90}Sr in pC/l, Ca in mg/l as follows: Genoa airport, 0.29, 0.21, 410; port of Genoa, 0.36, 0.23, 415; mouth of the Bisagno River, 0.42, 0.24, 367; Genoa-Vernazzola, 0.36, 0.22, 430; Genoa-Nervi, 0.28, 0.19, 421; Camogli, 0.30, 0.20, 432; Portofino, 0.25, 0.18, 400. All samples were taken about 3 m from the shore and from a depth of about 1 m. None of the values are particularly high; this is related to the small number of rivers in Liguria. (BBB)

18593 ON-STREAM X-RAY FLUORESCENCE ANALYSIS OF ORE SLURRIES WITH A RADIOISOTOPE X-RAY SOURCE. Carr-Brion, K. G.; Rhodes, J. R. (Atomic Energy Research Establishment, Wantage, Eng.). Instrum. Pract., 19: 1007-9(Nov. 1965).

An on-stream analyzer was developed using a twin slurry presenter with two identical source-detector units each measuring radiation through one of a pair of balanced filters. The ancillary electronic equipment consisted of A.E.R.E. 2000 series transistorized amplifiers and ratemeters suitable for use with the scintillation counter detectors. The source-detector is self-contained and connected to the rest of the equipment with a single cable which can have unlimited length and carries only a 6v supply together with the photomultiplier output. The signals from the twin unit are fed to two ratemeters connected to give the required count rate difference as a continuous output. The sources consist of a 2-mm dia ceramic sphere, with a frustoconical shield, the whole contained in an aluminium or steel casing. Available conical sources were ^{241}Am, ^{109}Cd, and ^{147}Pm bremsstrahlung. Experiments were performed with these primary sources and a range of secondary targets from Ni to Pb. The concentric source-target-detector assembly provided a sensitive and stable arrangement for nondispersive x-ray fluorescence analysis. By changing the target or the source, it could be used to determine any one of a very wide range of elements. On-stream x-ray analyzers using two of these assemblies with fixed balanced filters form compact, rugged, remotely controlled units with more than adequate reproducibility, sensitivity, and stability for most slurry analyses in process control. (TCO)

18594 THE BALANCED QUENCHING METHOD FOR COUNTING ^{14}C. Wright, E.; Castle, L. (Wallaceville Animal Research Centre, Wellington, New Zealand). Int. J. Appl. Radiat. Isotop., 17: 193-5(Mar. 1966).

The balanced quenching method for counting carbon-14 in a phosphor consisting of 4.0 g 2,5-diphenyloxazole and 0.3 g 2,2'-p-phenylene bis(5-phenyl) oxazole per liter of toluene is described. The activity was added as 0.1 ml of hexadecane-^{14}C in toluene. The quenchers used included: acetone, a chemical quencher; ethanol, a dilution quencher; and Fat Blue 2R and Sudan IV, color quenchers. The effects of quenchers on ^{14}C spectra are shown. (F.J.H.)

18595 DETERMINATION OF MERCURY IN POTATO FLOUR. Das, H. A.; van Raaphorst, J. G.; Hoede, D.; Zonderhuis, J. (Reactor Centrum Nederland, Petten). Int. J. Appl. Radiat. Isotop., 17: 252-3(Apr. 1966).

A method for the rapid and complete separation of ^{197}Hg from the other products of Hg neutron activation, ^{24}Na and ^{56}Mn, is discussed. The procedure was applied to a commercially available potato flour. Results of three runs were 5.4, 6.7, and 5.6 ppb ^{197}Hg, respectively. (H.G.D.)

18596 ASH CONTENTS OF COAL SAMPLES DETERMINED BY IONIZATION-CHAMBER BACKSCATTERING GAGING. Koch, S.; Schleife, F. (Technische Univ., Dresden). Isotopenpraxis, 1: 104-9(Dec. 1965). (In German).

Accuracy of measurements in determining ash contents by beta backscattering techniques was studied by using the probe and the central desk of the thickness gage VA-T-70 A. The measurements were carried out in samples of fine-grained bulk material as well as in briquettes. Lignite samples from two mines were used. The mean error in measuring bulk material samples dried in air amounted to ±0.64 or ±0.75% of weight, that of the briquettes to ±0.88 or ±1.31% of weight. (auth)

18597 DETERMINATION OF CERIUM WITH TWO-WAY DIFFERENTIAL SPECTROPHOTOMETER. Ganopolskii, V. I.; Krivonozhnikova, L. G.; Barkovskii, V. F. (Ural State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 7: 555-8(1964). (In Russian).

The pernitrilotriacetate method using two-way differentiation during work with a constant batch (0.1 g) and with samples of absorbing-layer thickness of 1 cm was used for the determination of Ce in products of the separation of rare earth elements containing from 0.05 to 2.0% by weight of CeO_2 with error not greater than 5%. A batch of 1 g is recommended for analysis of products of a higher degree of purity; in this case, the interval of determinable CeO_2 content is between 0.005 to 0.2% by weight with the same accuracy. The sensitivity of the method under these conditions is 2.5×10^{-3}% CeO_2 with 10% error. (M.J.T.)

18598 SPECTROPHOTOMETRIC STUDY OF CERIUM (III) AND THORIUM(IV) CHELATES OF TRANS-1, 2-DIAMINOCYCLOHEXANE-N,N,N',N'-TETRAACETIC ACID (DCTA). Hseu, Tong-Ming; Young, Chung-Chang (National Taiwan Univ.). J. Chin. Chem. Soc. (Taiwan), Ser. II, 12: 69-81(Sept. 30, 1965).

Interactions between DCTA and Ce(III) ions were investigated spectrophotometrically. It was found that the Ce(III)-DCTA chelate in aqueous solution (pH 4.25) exhibits a characteristic absorption maximum at 305 mμ. The absorption of Ce(III)–DCTA chelate was considerably diminished by the addition of small amounts of Th(IV) ion. This phenomenon was used as the basis of a spectrophotometric scheme for the quantitative determination of Th(IV) and evaluation of the formation constant of Th(IV)–DCTA chelate. The composition of Ce(III)– and Th(IV)–DCTA chelates were 1:1 and the corresponding formation constants (log K_f) of the chelates were 16.87 and 23.76 at 25°C and an ionic strength of 0.1 (KNO_3), respectively. The application of this system to the determination of traces of Th(IV) was demonstrated. (auth)

18599 REVERSED-PHASE PAPER CHROMATOGRAPHY OF THE RARE EARTHS, THORIUM, AND URANIUM USING METHYLENEBIS(DI-n-HEXYLPHOSPHINE OXIDE) AS THE STATIONARY PHASE. O'Laughlin, Jerome W.; Kamin, George J.; Banks, Charles V. (Ames Lab., Ames, Iowa). J. Chromatogr., 21: 460-70(1966). (IS-1236).

Reversed-phase partition chromatography was used to separate the rare earths, thorium, and uranium on papers treated with methylenebis(di-n-hexylphosphine oxide), MHDPO. The separation factors between adjacent rare

earths were found to increase with the acid concentration in both nitric and hydrochloric media with the larger separation factors in nitric acid. Opposite trends were observed in hydrochloric and nitric acid. In the former case the partition coefficient increased with acid concentration, but in the latter case it decreased. This is explained on the basis of the solvation energies of the cations and anions, the mass action effect, and the competitive extraction of nitric and hydrochloric acid. Solvation number studies indicated a 1:1 adduct between MHDPO and the rare earth nitrates. Corresponding studies on the rare earth chlorides gave anomalous results. It was postulated this was caused by non-equilibrium conditions. (auth)

18600 DETERMINATION OF ^{14}C AND/OR TRITIUM IN THE METHYL GROUP OF ORGANIC COMPOUNDS. ISOTOPIC C-METHYL ANALYSIS. Kornhauser, A.; Nystrom, R. F. (Univ. of Illinois, Urbana). J. Label. Compounds, 1: 201-6(July-Sept. 1965).

Determination of the millimolar radioactivity of C-methyl groups in selected ^{14}C- and tritium-labeled compounds by modification of the Kuhn-Roth method is presented. Oxidation of the radioactive sample in an open vessel using a solution of sodium dichromate and sulfuric acid allows radioassay of the C-methyl group as acetic acid. This procedure was tested with a representative group of labeled compounds and found to be isotopically reliable. (auth)

18601 STUDIES ON FOCUSING CHROMATOGRAPHY. SEPARATION OF RADIOACTIVE NUCLIDES IN NEUTRON IRRADIATED URANIUM. Shinagawa, Mutsuaki; Oyoshi, Akira; Oyoshi, Emiko (Osaka Univ.). J. Nucl. Sci. Technol., (Tokyo), 2: 492-8(Dec. 1965).

U, Np, and fission products in neutron irradiated uranium oxide were separated from each other using focusing chromatography. Individual nuclides were determined by γ spectrometry. As complex forming agent, 1.0M lactic acid and 0.05M nitrilotriacetic acid (NTA) were tried, and various mixtures of hydrochloric acid and sodium chloride as complex decomposing agent. The efficacy of the forming and decomposing agents for the separation was observed with various solutions of electrolytes. In all cases, Tc, Mo, Ru, Rh, I, Zr, and one fraction of Np migrated toward the anode. As the hydrogen ion concentration of the complex decomposing solution was decreased, these nuclides became more easily separable. Te and a small amount of Np generally remained in the area of the spot where the sample was introduced. Sr and Ba always migrated toward the cathode. Rare earth elements were sensitive not only to the kind of complex forming agent used but also to the pH value of the decomposing solution. Np manifested three different modes of focusing characteristic, their proportions varying with the conditions of the separation system. The concluding result was that the system of 0.1M sodium chloride–1.0M lactic acid was found the most suitable for separating these multi-component mixtures. (auth)

18602 PRACTICAL APPLICATIONS OF ANALYSIS BY RADIOACTIVATION. DETERMINATION OF MANGANESE IN BOTANICAL SAMPLES. Pijck, J. (Univ. de Gand, Ghent). J. Pharm. Belg., 20: 131-6(Mar.-Apr. 1965). (In French).

Various botanical samples were either ashed or pulverized and dried to constant weight. After weighing, they were encapsulated in gelatin or polyethylene; they were then irradiated 5 min in a flux of 1.3×10^{12} neutrons/cm^{2}sec. The samples were then converted to MnO_2 by entraining with Mn^{2+}, addition of HCl and $HClO_4$ to dissolve the sample, precipitation with $KClO_3$ in HNO_3, redissolving in concentrated H_2O_2, and two reprecipitations. After collection on filter paper, the sample was analyzed by γ spectrometry at 0.845 Mev. Alternately, samples were analyzed by conversion to $HMnO_4$ through solution in H_2SO_4–$HClO_4$–HNO_3 after adding entraining Mn^{2+}, and oxidation by HIO_4 and distillation. The sample was analyzed radiometrically. Again alternatively, the sample was analyzed directly by γ spectrometry at 0.845 Mev. Samples at the 20 ppM level showed a standard deviation of 3 to 7%; at the 200 ppM level, standard deviation was 2 to 5%, using the conversion to $HMnO_4$ method. (BBB)

18603 MEASUREMENT OF THE URANIUM CONTENT IN URANIUM–ALUMINUM ALLOYS BY GAMMA RADIATION ABSORPTION. Neumann, O.; Saller, H. (NUKEM, Wolfgang, Ger.). Kerntechnik, 8: 57-9(Feb. 1966). (In German).

A device, based on the principle of γ absorption, was constructed for measurement of the uranium content in U–Al alloys. The design of the instrument and its calibration are described. Measurement techniques used and sources of error in the measurement are discussed. Results showed that the device can be used for measurements on rolled plates to determine the mean uranium concentration of the plate at various zones and also the uranium distribution over the plate. (J.S.R.)

18604 COMPARATIVE EXAMINATION OF METHODS FOR THE DETERMINATION OF URANIUM CONTENT IN URANIUM – ALUMINUM ALLOY PLATES. Neumann, O.; Saller, H. (NUKEM, Wolfgang, Ger.). Kerntechnik, 8: 60-3(Feb. 1966). (In German).

Density measurements, measurement of the eigenradiation, γ absorption methods, and chemical analysis were compared with respect to their efficiency for the determination of the uranium content of uranium–aluminum alloy plates. In selection of a method for industrial purposes, factors other than measurement accuracy must be considered. The results showed that density measurements are suitable for only relatively small countings. Measurement of the eigenradiation can be partially automated but apparatus cost is high. The γ absorption method can also be partially automated and its cost is lower. (J.S.R.)

18605 SOLVENT EXTRACTION OF URANIUM(VI) WITH MESITYL OXIDE. Dhara, S. C.; Khopkar, S. M. (Indian Inst. of Tech., Bombay). Mikrochim. Ichnoanal. Acta, No. 5-6, 931-5(Dec. 1965).

A fast and selective procedure was developed for the determination of uranium by extraction with mesityl oxide from a solution 1M in nitric acid and 0.5M in ammonium nitrate. The effects of foreign ions were investigated, and methods proposed for eliminating interference. (auth)

18606 AN ELECTROMETRIC STUDY OF THE QUANTITATIVE PRECIPITATION OF LANTHANUM(III) AS NORMAL CHROMATE. Prasad, Sarju; Nagar, Mani Shanker (Banaras Hindu Univ., Varanasi, India). Mikrochim. Ichnoanal. Acta, No. 5-6, 948-52(Dec. 1965).

A series of conductometric titrations of lanthanum(III) with potassium chromate was carried out successfully at 25 ± 0.5°C in a 40 to 50% aqueous ethanol medium. The overall effect of ethanol on the results was also studied. The curves obtained in the direct as well as reverse titrations showed a sharp break of the end points and indicated the formation of lanthanum chromate. The procedure affords a means for the accurate titrimetric determination of lanthanum. (auth)

18607 TRIPHENYLARSINE OXIDE AS AN ANALYTICAL REAGENT. Pietsch, R.; Nagl, G. (Univ., Graz, Austria). Mikrochim. Ichnoanal. Acta, No. 5-6, 1085-90(Dec. 1965). (In German).

The analytical properties of triphenylarsine oxide with regard to precipitation and extraction methods are described. Precipitations can be carried out with uranyl and bismuth ions from strong acid solution. In addition to uranyl, bismuth, thorium, and cerium(IV), the chromate and vanadate anions as well as the thiocyano and chloro complex of iron(III) can be extracted with this reagent. The composition of the uranyl and bismuth compounds is given and formulas are suggested. (auth)

18608 CONDUCTOMETRIC STUDIES ON THE QUANTITATIVE PRECIPITATION OF LANTHANUM, PRASEODYMIUM, AND NEODYMIUM AS NORMAL TUNGSTATE. Prasad, Sarju; Swarup, Rajendra (Banaras Hindu Univ., Varanasi, India). Mikrochim. Ichnoanal. Acta, No. 5-6, 1105-9(Dec. 1965).

Conductometric titrations of La, Pr, and Nd nitrates were carried out with sodium tungstate at 27 ± 0.5°C. Breaks were sharp and stoichiometric and corresponded to the formation of $R_2(WO_4)_3$ (R = La, Pr, and Nd). The results were good even at low concentrations of the rare

earths. The effect of ethanol was also studied. The procedure offers a convenient and accurate method for the microdetermination of rare earths. (auth)

18609 ON THE USE OF ^{139}Ba FOR TOTAL SULFUR DETERMINATION IN BIOLOGICAL MATERIALS. INVESTIGATIONS ON THE PRECIPITATION OF SO_4^{2-} WITH $^{139}Ba^{2+}$ AFTER PREVIOUS SCHOENIGER OR CARIUS DECOMPOSITION OF THE ORGANIC MATERIALS. Putz, M.; Altmann, H.; Szilvinyi, A. v.; Kaindl, K. (Reaktorzentrum, Seibersdorf, Austria. Hochschule fuer Bodenkultur, Vienna). Mikrochim. Ichnoanal. Acta, No. 5-6, 1171-7(Dec. 1965). (In German).

A method for determining the total sulfur in organic material is described. This method is especially suited to quantities of sulfur from 10 μg and upwards. It is based on the precipitation of sulfate by means of ^{139}Ba, whose gamma radiation can be readily measured. (auth)

18610 ESTIMATION OF MOISTURE CONTENT BY NEUTRON SCATTERING: EFFECT OF SAMPLE DENSITY AND COMPOSITION. Waters, E. H.; Moss, G. F. (CSIRO, Melbourne). Nature, 209: 287-9(Jan. 15, 1966).

The response of a commercial surface-type instrument to changes of moisture content in building materials was examined. The results obtained from four specimens of concretes, each of which included Portland cement, are shown in which the relative thermal neutron count is plotted as a function of the equivalent water content. It is inferred from these observations that the thermalizing power of atoms other than hydrogen cannot be neglected and that it is necessary to consider both the density and the type of other atoms present. The variation of the total cross section of hydrogen and oxygen with neutron energy is also shown. (J.F.P.)

18611 X-RAY FLUORESCENT SPECTROMETRIC DETERMINATION OF YTTRIUM IN SOLUTION FORM. Shiokawa, Jiro; Shin-ike, Tsutomu; Adachi, Gin-ya; Ishino, Toshio (Osaka Univ.). Nippon Kagaku Zasshi, 87: 131-4(Feb. 1966). (In Japanese).

The x-ray fluorescent spectrometric determination of ytterium in aqueous solutions was studied. When an aqueous solution of hydrochloric acid was used as solvent, the intensities of the $Y-K_\alpha$ line decreased with the increasing concentrations of the acid. When an aqueous solution of nitric acid was used, its concentration had little influence on the intensities of the spectrum. Plottings of the intensities of the $Y-K_\alpha$ line against the concentration of yttrium gave a straight line in the range from 0.8 to 2.5 g (Y_2O_3)/l. Presence of heavy rare earths such as gadolinium, dysprosium, holmium, erbium, and ytterbium reduced the intensities of the $Y-K_\alpha$ line, but at a fixed concentration of impurities, the linear relations between concentration of yttrium and the intensities of the spectrum existed in the range mentioned above. Therefore, "addition method of standard sample" was suitable for determining yttrium in rare earth mixtures. When synthetic samples were analyzed by this method, good results were obtained. (auth)

18612 POLAROGRAPHIC DETERMINATION OF URANIUM IN BICARBONATE SOLUTION. Hagiwara, Kazuyoshi (Government Industrial Research Inst., Osaka). Nippon Kagaku Zasshi, 87: 143-6(Feb. 1966). (In Japanese).

It was found that uranyl ions in bicarbonate solutions form bicarbonate complexes and show the reduction wave at −0.95 v (vs. SCE). The slope of log $i/(i_d - i) - E$ of this wave is 93 mv and the electrode reaction seems to be irreversible. The value of $i_l/h^{\frac{1}{2}}_{corr.}$ is constant and the temperature coefficient of i_l is 1.54%°C, which indicate that the limiting current is diffusion-controlled. With increasing pH, the half wave potential was slightly shifted to more positive side. The composition of complexes in bicarbonate solution at various pH did not change markedly. The calibration curve at pH 8.3 was linear in the range of 0.5×10^{-4} to 3×10^{-3} mol/l of uranium. Copper, lead, bismuth, cobalt, nickel, zinc, cadmium, chromium(III), iron(III), vanadium(V), and molybdenum(IV) did not interfere with this determination. (auth)

18613 ACTIVATION ANALYSIS OF COBALT AND NICKEL IN IRON BY MEANS OF PHOTONUCLEAR REACTION. Oka, Yoshinaga; Kato, Toyoaki; Nomura, Koichi (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 87: 147-53(Feb. 1966). (In Japanese).

CoO, Fe_2O_3, and NiO targets were photoactivated by bremsstrahlung (about 9×10^6 roentgens/min) for 1 hr, using a linear accelerator operated with a maximum electron energy of 20 Mev. The residual radioactive nuclides were investigated to establish the method for nondestructive determinations of Co and Ni in Fe. The main photonuclear reactions produced were $^{54}Fe(\gamma,n)^{53}Fe$, $^{57}Fe(\gamma,p)^{56}Mn$, $^{59}Co(\gamma,n)^{58}Co$, $^{58}Ni(\gamma,n)^{57}Ni$, and $^{58}Ni(\gamma,p)^{57}Co$, and the radioactivity of their residual radionuclides were estimated as 1.7 μC ^{53}Fe/mg Fe, 0.081 μC ^{56}Mn/mg Fe, 0.063 μC ^{58}Co/mg Co, 1.3 μC ^{57}Ni/mg Ni and 0.015 μC ^{57}Co/mg Ni, respectively. The matrix Fe was employed as an internal monitor of bremsstrahlung flux to which the sample was exposed. When synthetic mixtures of Fe_2O_3-CoO with different mixing ratios were photoactivated by the conditions described above, a linear relation was obtained between the ratios of the photoelectric peak intensities at a time of the end of bombardment, R_{A_0} = ^{58}Co(cpm at 0.803 Mev)/^{56}Mn(cpm at 1.81 Mev), and the ratios of the weights, R_W = CoO/Fe_2O_3. By a similar treatment, a proportionality was also obtained in Fe_2O_3-NiO system between R_{A_0} (=^{57}Ni (cpm at 1.37 Mev)/^{56}Mn(cpm at 0.845 Mev)) and R_W(=NiO/Fe_2O_3). Using these relations the respective contents of Co and Ni in a sample of Fe could be determined nondestructively. The determination limits of Co and Ni were about 100 ppm and 50 ppm, respectively. The coexistence of Mn and Cu caused appreciable interferences. (auth)

18614 DETERMINATION OF RHODIUM AND RHENIUM IN PLATINUM–RHODIUM AND PLATINUM–RHENIUM MIXTURES BY PHOTOACTIVATION ANALYSIS. Oka, Yoshinaga; Kato, Toyoaki; Saito, Tatsuya (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 87: 154-8(Feb. 1966). (In Japanese).

Targets of six metals of the platinum group and rhenium were bombarded for 1 hr by bremsstrahlung gammas about 9×10^6 roentgens/min) and the radioactive nuclides were investigated in order to establish methods for the nondestructive determinations of Rh and Re, in Pt−Rh and Pt−Re mixtures by means of photonuclear reactions and gamma spectrometry, using a linear accelerator operated with a maximum energy of 20 Mev. The radioactivity of ^{102}Rh and ^{184}Re produced by (γ,n) reaction of the elements were sufficient for determining the contents of each element. The matrix Pt was used as an internal monitor of bremsstrahlung gamma flux to which the sample was exposed. When synthetic mixtures of Pt−Rh with different mixing ratios were photoactivated by the conditions as described above, a linear relation was obtained between the ratios of the photoelectric peak intensities at the end of bombardment, R_{A_0} = cpm (^{102}Rh 0.475 Mev)/cpm (^{191}Pt 0.539 Mev) and the ratios of the weights, R_W = Rh/Pt. By a similar treatment, a proportionality was also obtained in Pt−Re system between R_{A_0} = cpm (^{184}Re 0.793 or 0.904 Mev)/cpm (^{191}Pt 0.539 Mev) and R_W = Re/Pt. Hence, by using these relations, the contents of Rh and Re in samples of Pt−Rh and Pt−Re mixtures can be estimated. Sensitivities of ~15 μg for Rh and ~10 μg for Re were obtained. The precision obtained under present conditions was within 10% for both elements. (auth)

18615 EVALUATION OF THE RADIOACTIVITY IN DRINKING WATER. Schnabl, H. Phys. Bl., 21: 511-13 (Nov. 1965). (In German).

Techniques to be followed in evaluating the radiocontamination of drinking water are briefly outlined. (J.S.R.)

18616 INSTALLATION AND USE OF THE ACTIVATION ANALYSIS LABORATORY AT THE NUCLEAR SCIENCE CENTER, LOUISIANA STATE UNIVERSITY. Iddings, Frank A.; Decell, Robert F. (Louisiana State Univ., Baton Rouge). Proc. Louisiana Acad. Sci., 28: 135-43(Dec. 1965).

Components of an activation analysis unit designed for teaching, analysis, and engineering are described, with emphasis on the generator, flux monitor, transfer system, control system, and shielding and safety. Performance of the system in neutron radiography and analysis is discussed. (H.G.D.)

18617 AMOUNT OF CESIUM IN PHOTOEMISSIVE CELLS BY γ SPECTROMETRY. Mesnard, Guy; Schmitt, Roger; Uzan, Robert; Vicario, Edmond (Univ., Lyon). Rev. Opt., 44: 9-19(Jan. 1965). (In French)

A method was developed to determine the amount of Cs existing in the photoemissive layer of Cs–Sb cells and variations in cells as a result of various treatments. This method makes use of ^{134}Cs through analysis of its γ emission. Various parameters of the detector are discussed, particularly the NaI crystal used as detector and the diameter of the Pb diaphragm. Experimental results are given for determination of the amount of Cs on the photocathode, and for measurement of the quantity of Cs as a function of irradiation of the sample with light. A sigmoid curve was obtained when the photoelectric current was plotted vs the number of atoms/mm^2; when the sample was heated, the number of atoms/mm^2 increased sharply then decreased linearly through several periods of heating. The chief difficulty was due to the presence of Cs in the bulb itself, outside the emissive layer. There was considerable uncertainty in the measurements; this could be decreased by increasing the specific activity of the Cs used. (BBB)

18618 ACTIVATION ANALYSIS OF UNGULATE HAIR. Kennington, Garth S. (Univ. of Wyoming, Laramie); Ching, Clarence F. T. Science, 151: 1085-6(Mar. 4, 1966).

Hair samples from the horse, elk, deer, moose, and antelope; subcutaneous tissue from the moose and antelope; and cast and living skin of the rattlesnake were activated by exposure to a neutron flux. The resulting products were studied by pulse-height analysis. Differences in type and proportion of trace elements appear to be consistent within the species studied. (auth)

18619 ANALYTICAL METHODS FOR URANIUM CONCENTRATION MEASUREMENTS. Rodden, C. J.; Highfill, J. P. (Atomic Energy Commission, New Brunswick, N. J.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-67/32, 26p. (CONF-650803–41). ORAU.

From IAEA Symposium on Nuclear Materials Management, Vienna.

A survey of analytical procedures for the determination of uranium, as performed for nuclear materials management in the United States, is presented. Methods are outlined for the measurement of the element in a variety of materials, i.e., ores, concentrates, uranium metal, alloys, ceramics, compounds of uranium, scrap processing solutions, residues, and waste stream products. Methods of analysis to a large extent are dictated by the types of material to be analyzed. The use of gravimetric methods are reviewed pertaining to product materials, which are generally defined as uranium metal, or compounds of the metal, such as oxides, halides, or nitrates. A pyrohydrolysis technique is included. Nonvolatile metallic impurities are determined spectroscopically, and the gravimetric results are corrected accordingly. Volumetric procedures are thoroughly explored. The technique is applicable to all types of material, providing the uranium available for measurement is present in milligram quantities. Due to the valence states of uranium, reduction-oxidation schemes are considered particularly attractive. Dissolution problems, separation of interfering elements, reduction steps, and oxidation titrations of reduced uranium are discussed. The application of certain spectrophotometric and fluorometric procedures for analyzing low-grade materials are included. Various separation steps incorporated in the procedures prior to the determination of uranium are reviewed. Along these lines the utilization of differential colorimetry is examined for determining uranium in impure material. Development of measurement methods in the fields of coulometry, gamma absorptiometry, and x-ray analysis are discussed, with emphasis placed on the limits and applicability of these techniques. Finally, the subject of standard reference materials is dealt with along with information regarding analytical evaluation programs conducted in the United States for the purpose of obtaining better analytical data. (auth)

18620 SEQUENTIAL SIGNAL SELECTOR SYSTEM. Bayly, John G.; Stevens, William H. (to Atomic Energy of Canada, Ltd.). Canadian Patent 722,813. Nov. 30, 1965.

The isotopic composition of water can be found by observing the relative absorption of certain infrared wavelengths. The sample to be analyzed flows between two windows which form a thin cell. A rotating disc having filters capable of transmitting only certain desirable wavelengths is placed in front of the cell and illuminated by a non-collimated infrared source. A detector of the transmitted energy gives electric pulses whose ratio depends on the water composition. The pulse ratio is measured by a suitable circuit which operates a multi-position switch. From the action of the latter a composition of the water sample may be read. Details of the filters and the necessary circuits are described. (F.S.A.)

18621 APPARATUS FOR IDENTIFYING MATERIALS BY ACTIVATION ANALYSIS. Verbinski, Victor V. (to General Electric Co.). U. S. Patent 3,234,387. Feb. 18, 1966. Filed Jan. 3, 1962.

A method and apparatus are patented for activation analysis in which the material to be identified is irradiated with short duration pulses of incident radiant energy. The pulsed irradiation causes an emitted radiation from the material and an appropriate detector senses this emitted radiation. The detector is shielded from radiation originating from sources other than the material to be identified, and a gated counting circuit is coupled to the output of the detector to further minimize the effects of induced radioactivity caused by other reaction products, and to reduce the undesired background radiation to result in more sensitive measurement of the radiation that identifies the particular element. (B.L.M.)

Inorganic and Physical Chemistry

Refer also to abstracts 19135 and 20161.

18622 (CEA-Bib-57) PROPRIETES PHYSIQUES ET CHIMIQUES DE L'AMMONIAC. COMPILATION BIBLIOGRAPHIQUE. (Physical and Chemical Properties of Ammonia. Bibliographic Compilation). Jacolin, Odile (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 66p. Dep. mn.

A review is presented on the physical and chemical properties of ammonia along with preparation, corrosion, and decomposition. Data are presented in the form of diagrams at various temperatures and pressures. (18 references.) (P.C.H.)

18623 (CEA-Bib-58) LES COMPOSES CHIMIQUES DES GAZ RARES. (Chemical Compounds Formed by the Rare Gases). Kuhn, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 1966. 38p. Dep. mn.

A review is presented on the properties of rare gas atoms and the preparation and properties of all known compounds up to January 1, 1965. Different theories attempting to explain the existence of these compounds were examined and some applications are described. (139 references.) (auth)

18624 (CU-2660-24) CAPILLARY PROPERTIES OF ALKALI METAL SYSTEMS. I. SURFACE TENSION OF POTASSIUM UNDER ARGON. II. INTERFACIAL TENSION OF LITHIUM AND LITHIUM CHLORIDE [Thesis]. Chung, Jin-Wook (Columbia Univ., New York. School of Engineering and Applied Science). [1965]. Contract AT(30-1)-2660. 97p. ORAU.

A modified maximum bubble pressure method using two capillaries of different sizes was devised and used to measure the surface tension of potassium from its melting point

to its boiling point, and the interfacial tension of the Li–LiCl system over the temperature range 618.5 to 844°C. The apparatus, which is made of stainless steel type 304, was designed so that the larger capillary can be closed off or opened by a valve. This avoids the necessity of measuring the liquid depth over the tip of the capillary for correcting the observed pressure. In addition, the critical temperature of potassium was estimated from the surface tension-temperature relationship. The value obtained showed close agreement with some of the published estimates. The interfacial tension of the Li–LiCl system gave close agreement with values predicted by Antonoff's rule. All computations were done with an IBM-7094 digital computer using the complete form of Schroedinger's equation. (auth)

18625 (EUR-2646.e) THE RETENTION OF ORGANIC AND INORGANIC COMPOUNDS ON CLAY MINERALS. PART I. BASIC STUDIES ON ATTAPULGUS CLAY. Nordmeyer, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 1966. 92p. Dep. mn.

With regard to organic reactor coolant purification a fundamental characterization of Attapulgus clay is given, summing up literature data as well as completing these data with an intensive study on the behavior of natural and technically activated Attapulgus clay samples at elevated temperatures. Chemical analysis, granulometry, mineralogical composition, and crystal structure of the clay and clay components are reported. Thermal dehydration and phase changes with rising temperature were followed by differential thermal analysis, x-rays, and electron micrographs. The influence of thermal activation on the dehydration process, on cation absorption, and specific surface areas is demonstrated. Observations on terphenyl-clay contacts and Attapulgus grain stability are given. (auth)

18626 (GA-6865) THE USE OF RADIOACTIVE TRACERS FOR ADSORPTION ISOTHERM MEASUREMENTS. Burnette, R. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Dec. 29, 1965. Contract AT(04-3)-633. 11p. (CONF-660506-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Inst. of Chemical Engineers, Nuclear Engineering Div. Symposium, Columbus, Ohio.

A sensitive technique for the determination of adsorption isotherms using radioactive tracers was developed. The method involves the use of a small helium loop wherein the desired adsorbate (appropriately tagged) is circulated through a test adsorbent bed. The gas also passes through an in-line ionization chamber which continuously monitors the gas phase adsorbate concentration. Sorbed phase concentrations are calculated from the change in gas phase adsorbate level during equilibration. This technique was used to determine low pressure Xe and Kr isotherms on 4 and 5A molecular sieves. Equilibrium adsorbate pressures as low as 7.8×10^{-8} atm and sorbed phase concentrations down to 6.5×10^{-6} cm^3(STP)/g were measured. (auth)

18627 (NIJS-R-459) HYDRAZINIUM HEPTAFLUOROURANATE (V). THE THERMAL DECOMPOSITION. Frlec, B.; Brcic, B. S.; Slivnik, J. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Aug. 1965. 7p. Dep. mn.

The thermal decomposition of hydrazinium heptafluorouranate (V) involving self-reduction to UF_4 at 70 to 380°C was studied by differential thermal analysis, thermogravimetric analysis and isothermal decomposition step by step. Nonvolatile decomposition products were characterized by chemical and x-ray-powder-diffraction analysis and by measurements of the magnetic susceptibility. (auth)

18628 (NIJS-R-460) HYDRAZINIUM HEPTAFLUOROURANATE (V). THE PREPARATION AND PROPERTIES. Frlec, B.; Brcic, B. S.; Slivnik, J. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Sept. 1965. 10p. Dep. mn.

The reaction of uranium hexafluoride with hydrazinium difluoride in anhydrous hydrogen fluoride and carbon tetrachloride was investigated. A detailed description of the synthesis of hydrazinium heptafluorouranate (V) ($N_2H_6UF_7$) is given. X-ray-powder-diffraction photographs of the product were taken and the magnetic susceptibility was measured. During hydrolysis of $N_2H_6UF_7$ a green precipitate, hydrazinium pentafluorouranate (IV) is formed. (auth)

18629 (NP-15353) THERMODYNAMIQUE ET THERMOCHIMIE DES ECHANGES ENTRE L'ION BARYUM ET LES CATIONS ALCALINS DANS LES ARGILES. (Thermodynamics and Thermochemistry of Exchanges Between the Barium Ion and the Alkaline Cations in Clays). Progress Report on a Study of Ion Exchange Equilibria in Soils and Clays. van Bladel, R.; Laudelout, H. (Louvain Univ. (Belgium). Inst. of Agronomy). June 1965. 52p. Dep. mn.

The thermodynamic functions corresponding to the exchange $2NH_4$ zeolite(Z) + $BaCl_2 \rightleftharpoons$ Z Ba Z + $2NH_4Cl$ were established from the exchange isotherms between an exchanger (Camp Berteau Montmorillonite) saturated with ammonia and a mixed solution of electrolytes (ammonium chloride and barium chloride) with constant total normality for a test but with variable ratio of the normalities of the two cations. The results were completed by a study of the reaction 2 Na Z + $BaCl_2 \rightleftharpoons$ Ba Z + 2NaCl in which the standard variation of the thermodynamic potential and the exchange enthalpy were determined by the same methods indicated. Calculation of the partial molar magnitudes and of the thermodynamic functions of relative excess with these exchanges are discussed. (P.C.H.)

18630 (NP-15896) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS. No. 17. (National Bureau of Standards, Washington, D. C.). Dec. 31, 1965. 30p. NBS Free.

References (343) are given to journals and reports published from 1962 to 1965. The areas covered are: spectroscopy in high-temperature chemistry; reactions between gases and condensed phases; and thermodynamics of plasmas. (J.G.B.)

18631 (NYO-2266-1) THE COPRECIPITATION OF METALLIC IONS WITH CALCIUM CARBONATE. Final Report. Holland, H. D. (Princeton Univ., N. J. Dept. of Geology). Feb. 1, 1966. Contract AT(30-1)-2266. 98p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Studies were made on the composition of solutions from which a single mineral has been deposited. Emphasis was made on understanding the behavior of trace elements in the carbonate minerals calcite and aragonite. The metallic ions studied include Sr, Mn, Mg, Zn, and Cd. Relatively few difficulties were experienced in studying the coprecipitation of Sr^{2+} with $CaCO_3$. The coprecipitation of Mn^{2+} with $CaCO_3$ turned out to be similarly straightforward, but the coprecipitation of Zn^{2+} was complicated by the presence of extensive complexing in concentrated chloride solutions, and the study of the $CaCO_3$–$MgCO_3$ system was beset by difficult kinetic problems. Field observations and laboratory measurements on natural materials are also reported. The majority of these studies were done in northern Mexico in and around the Providencia mining area. However, some work was also done in caves, calcites from Mississippi Valley type ore deposits, limestones of the Steinplatte Reef complex in Austria, and on carbonate sediments in the Bahamas. (P.C.H.)

18632 (NYO-3450-1, pp 91-107) SOME THOUGHTS ON GASES DISSOLVED IN THE OCEANS. Benson, Bruce B. (Amherst Coll., Mass. Dept. of Physics).

Various physico-chemical factors that influence dissolved gas concentrations in sea water are discussed with the purposes of suggesting the most useful kinds of measurements for various problems and some possible procedures for treating the data. The factors considered include: atmospheric pressure; sea-surface state; and air-sea temperature differences. An idealized model for using gas measurements to unscramble various surface effects is described. (P.C.H.)

18633 (NYO-3450-1, pp 203-11) MARINE GEOCHEMISTRY: SOME GUESSES AND GADGETS. Carritt, Dayton E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics).

The role of chemistry in building a better understanding of what goes on in the oceans and across its immediate boundaries is discussed. Particulates are also discussed. Two techniques used in taking and handling samples at sea are described and evaluated. These are: a device for collecting and concentrating a group of trace elements from large volumes of sea water; and stripping voltammetry. (P.C.H.)

18634 (SRIA–106–37) THE VAPOR PRESSURE AND ENTHALPY OF VAPORIZATION OF MOLTEN MERCURIC CHLORIDE TO THE CRITICAL POINT. Technical Report No. XLI. Johnson, J. W.; Silva, W. J.; Cubicciotti, D. (Stanford Research Inst., Menlo Park, Calif.). Mar. 7, 1966. Contract AT(04-3)-106. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The vapor pressure of molten mercuric chloride was measured by an inverted capillary technique from 573°K and 0.96 atm to 968°K and 111.6 atm. The data are fitted by the linear relation log P(atm) = 4.9929 – 2,854.8/T°K from 660 to 968°K with an average deviation of 0.9% for the 25 experimental points. Below 660°K the experimental points fall below the linear relationship. A critical pressure of 113.7 ± 1.6 atm is predicted by the linear equation at a critical temperature of 972 ± 2°K. The enthalpy of vaporization of molten mercuric chloride was calculated from 700 to 970°K. (auth)

18635 (STI-PUB-107) EXCHANGE REACTIONS. Proceedings Series. Proceedings of the Symposium held at the Brookhaven National Lab., Upton, N.Y., May 31–June 4, 1965. (International Atomic Energy Agency, Vienna (Austria)). Oct. 1965. 420p. (CONF-650549). IAEA: $9.00; S189,-; £ 3.14.0; F Fr. 36,-; DM 31,50.

Twenty-nine articles containing information: on oxidation-reduction reactions in which the net result is the transfer of one or more electrons between the different oxidation states of the same element; transfer of protons, atoms, complex ligands, or organic radicals between molecules; and heterogeneous exchange are included. (P.C.H.)

18636 (TID–22725) POLAROGRAPHY IN NON-AQUEOUS SOLVENTS. Final Report, 1951–1966; Annual Report, 1965–1966. De Vries, Thos. (Purdue Research Foundation, Lafayette, Ind. Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Mar. 1966. Contract AT(11-1)-163. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Polarographic techniques were used to study the reduction of organic compounds in organic solvents and inorganic cations in fused salts. The study was directed to determine which variables influenced polarographic data such as wave height, half-wave potentials, and heterogeneous reaction rate constants. The results are presented in two sections: the use of organic compounds as solvents and use of fused salts. (P.C.H.)

18637 (KFK-tr–177) BERECHNUNG DER THERMODYNAMISCHEN FUNKTIONEN VON GASFOERMIGEM URAN UND PLUTONIUM UND DEREN IONEN BIS ZU 20,000 DEG K. (Calculation of the Thermodynamic Functions of Gaseous Uranium and Plutonium and Their Ions up to 20,000 deg K). Gurvic, L. V.; Jungman, V. S. Translated into German by Liselotte Neander (Kernforschungszentrum, Karlsruhe, West Ger.), from report SM–66/41. 1964. 12p. (CONF-650704–35). Dep. mn. JCL $1.60 fs, $0.80 mf.

From IAEA Symposium on Thermodynamics, Vienna.

The thermodynamic functions of monoatomic U, Pu, and their ions in the state of an ideal gas were calculated at temperatures from 298.15 to 20,000°K. Calculation of the thermodynamic functions of monoatomic gases in so broad a temperature range requires the solution of two problems: determination of the total system of energy levels of the corresponding atoms and ions and the correct limitation of the statistical sums. In the present calculation no limitation was made. All known energy levels of U, Pu, and their ions were considered. The errors resulting are discussed, and results are tabulated. (J.S.R.)

18638 THE CHEMISTRY OF PROTACTINIUM. Keller, C. (Technische Hochschule, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl., 5: 23-35(Jan. 1966).

Protactinium exhibits an ambivalent chemical behavior. In nonaqueous solutions and in the solid state, both quadrivalent and quinquevalent protactinium have properties, which characterize them as typical actinide elements. Investigations in aqueous solution show quinquevalent protactinium to be a homolog of niobium and tantalum. It exhibits, except in hydrofluoric acid solutions, a marked tendency to undergo irreversible hydrolysis and condensation reactions, which leads to the situation that trace amounts (ca 10^{-12} mole/l) and macroscopic amounts (10^{-3} to 10^{-6} mole/l) of protactinium often behave differently. Reduction with strong reducing agents gave aqueous solutions of Pa(IV), the properties of which again corresponded in general to those of Th(IV) and showed no relation to Nb(IV). Knowledge of the chemical behavior of this rare radioelement was advanced, in particular, by the production in 1958 to 1960 of 100 g of pure protactinium from residues of the British production of uranium. (auth)

18639 ISOTOPE EFFECTS ON VIBRATIONAL TRANSITION PROBABILITIES. IV. ELECTRONIC TRANSITIONS OF ISOTOPIC C_2, CO, CN, H_2, AND CH MOLECULES. Halmann, M.; Laulicht, I. (Weizmann Inst. of Science, Rehovoth, Israel). Astrophys. J. Suppl. Ser., 12: Suppl. No. 110, 307-22(Feb. 1966).

Franck-Condon factors based on Morse potentials are presented for many important electronic transitions of the normal and stable-isotope-labeled molecules C_2, CO, CN, H_2, and CH, for the $v'' = 0$ progression up to $v' = 10$, for the $v' = 0$ progression up to $v'' = 10$, and for the (1,1) band. Appreciable isotope effects on vibrational transition probability were found for all transitions involving large changes in equilibrium internuclear distances, such as the C_2, Phillips and Fox-Herzberg bands, the CO Asundi, Cameron and Hopfield-Birge a bands, and the H_2, Lyman and Werner bands. Harmonic oscillator Franck-Condon factors for (0,0) transitions of alkali metal hydrides versus deuterides are subject to very large isotope effects. (auth)

18640 STUDIES OF THE CHEMICAL REACTIONS OF URANIUM IODIDE WITH OXYGEN AND IODINE AT HIGH TEMPERATURES. Handa, Muneo (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Jap., 39: 321-6 (Feb. 1966).

Uranium tetraiodide is oxidized to triuranium octoxide through three intermediates, which are deposited on silica powder heated to temperatures of about 400, 300, and 200°C, respectively. The intermediates are produced by the action of oxygen contained in small amounts in a helium stream (1/100 to 1/10000 atm.) on uranium tetraiodide. The intermediates are considered to be compounds consisting of uranium, iodine, and oxygen. Chemical analysis, measurements of melting point, and x-ray analysis showed that the compound deposited at the temperature of 400°C is uranium triiodide, while the compounds deposited at 300 and 200°C were both uranium tetraiodides. Three hypotheses were formulated to interpret the above phenomenon, in which the reaction of uranium iodides with iodine was studied. (auth)

18641 SUGGESTED SEMIEMPIRICAL MOLECULAR ORBITAL SCHEMES FOR XENON TETROXIDE. Yeranos, Walter A.; Winter, Nicholas W. (Northern Illinois Univ., DeKalb). Bull. Soc. Chim. Belges, 75: 116-26(Jan.-Feb. 1966).

Using recently published approximate SCF wave functions for xenon, the one-electron molecular orbital energies of xenon tetroxide were determined in three approximations and within the general formalism of the semiempirical Mulliken-Wolfsberg-Helmholtz molecular orbital method. The bonding and symmetry-allowed electronic transitions are discussed qualitatively. (auth)

18642 SELENIUM ISOTOPE EFFECTS IN THE REDUCTION OF SODIUM SELENITE AND OF SODIUM SELENATE. Rees, C. E.; Thode, H. G. (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 44: 419-27(Feb. 15, 1966).

Selenium isotope effects in the reduction of sodium selenite and of sodium selenate were studied. Rate constant ratios for the ^{76}Se and ^{82}Se species were determined

for the reactions $Se^{iv} \rightarrow Se^{0}$ (1.017), $Se^{vi} \rightarrow Se^{iv}$ (1.018), and $Se^{0} \rightarrow Se^{iv}$ (1.010) at room temperature. Theoretical predictions of the first two ratios, from use of models in which the rate-controlling steps were assumed to be Se–O bond cleavages in SeO_3^{2-}, respectively, led to predictions in good agreement with experiment. (auth)

18643 THE SOLVENT ISOTOPE EFFECT AND THE PARTIAL MOLAR VOLUME OF IONS. Robertson, R. E.; Sugamori, S. E.; Wu, C.-Y. (N. R. C., Ottawa). Can. J. Chem., 44: 487-94(Feb. 15, 1966). (NRC–8781).

The partial molar volume of ions in water furnishes an indication, if not precise information, about the nature of ionic solvation. Accordingly, it was hoped that differences in this term and particularly the effect of temperatures on the differences in the apparent partial molar volume for a series of ions in light and heavy water would provide a basis for decisions on the nature of solvation of the benzenesulfonic ion. This ion is of considerable interest in the study of solvolysis, but very little is known about the characteristics of solvation. (auth)

18644 NEW DOUBLE SULFIDES OF RARE EARTHS AND COPPER. Ballestracci, Regis; Bertaut, Erwin Felix (Laboratoire d'Electrostatique et de Physique du Metal, Isere, France. Centre d'Etudes Nucleaires de Grenoble, Isere, France). Compt. Rend., 261: 5064-7(Dec. 8, 1965). (In French).

Sulfur compounds of copper and rare earths showing a certain number of phases were studied. The C_0 phase for the rare earths between Tb and Lu has a lacune structure of the group P 3 hexagonal type. The rare earth is in the (000) plane and the sulfur and copper in $\pm(\frac{1}{3}, \frac{2}{3}, z)$ with $z_S \sim 0.75$ and $z_{Cu} \sim 0.38$. (tr-auth)

18645 THE STRUCTURE AND THE STABILITY OF THE INTERMEDIARY PHASES OF THE LIME–HAFNIUM OXIDE SYSTEM. Delamarre, Claude; Perez Y Jorba, Monique (CNRS, Vitry-sur-Seine, France). Compt. Rend., 261: 5128-31(Dec. 8, 1965). (In French).

Samples of the lime–hafnium oxide system were prepared by solid-state reactions between hafnium oxide and calcium carbonate. The hafnium oxide is monoclinic at low temperature and tetragonal at high temperature; the structures of the two forms are derived from the fluorite structure by deformation. The structure and stability of the $CaO-HfO_2$ system were studied. The addition of CaO to HfO_2 stabilizes the cubic form of fluorite type. For equal molecular composition the compound $CaHfO_3$ appeared which is stable at all temperatures. For a concentration of 20 mol. % CaO a rigorously stoichiometric compound, $CaHf_4O_9$, stable below 1450°C was formed. The lattice parameters of the two stoichiometric compositions were determined. (J.S.R.)

18646 REACTION OF URANYL HALIDES WITH TRI-N-BUTYLPHOSPHINE OXIDE. Sinitsyna, S. M.; Sinitsyn, N. M. (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 351-3(Sept. 11, 1965). (In Russian).

A number of complexes were formed between uranyl dihalides and tri-n-butylphosphine oxide (TBPO). Freshly prepared uranium trioxide was dissolved in stoichiometric amounts of the appropriate hydrohalic acid, followed by addition of TBPO in n-heptane (U : TBPO = 1 : 2). The following complexes were obtained: $[(UO_2)_6F_{12}(TBPO)_8]$, $[UO_2Cl_2(TBPO)_2]$, $[UO_2Br_2(TBPO)_2]$, and $[UO_2I_2(TBPO)_4]$. Cryoscopic molecular-weight determinations in benzene indicated that the fluoride complex existed in benzene in the form of a hexamer, the chloride complex as a tetramer, and the bromide and iodide complexes as monomers. There was evidence for the existence of bridging halogen bonds between individual complex molecules. (CFSTI)

18647 CERTAIN CARBAMIDE-CONTAINING THORIUM HALOGENIDE COMPLEXES. Molodkin, A. K.; Ivanova, O. M.; Kuchumova, A. N. (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 820-1(Oct. 1, 1965). (In Russian).

Reactions of carbamide with certain Th salts were examined. In order to eliminate the effect of water molecules, the following carbamide-containing complex thorium halides were prepared in methanol solution: $ThCl_4 \cdot 6(NH_2)_2 \cdot 2H_2O$; $ThCl_4 \cdot 8(NH_2)_2CO$; $ThBr_4 \cdot 6(NH_2)_2 \cdot 2H_2$; $ThBr_4 \cdot 8(NH_2)_2CO$; and $ThI_4 \cdot 8(NH_2)_2CO$. These crystalline diamagnetic materials were identified by crystal optics, thermogravimetric, and infrared absorption techniques. They are easily soluble in methanol and water and insoluble in ether, benzene, and acetone. Molecular electric conductivity data indicate that they dissociate in aqueous solutions but are stable in absolute methanol. The 8-coordination compounds are decomposed thermally at 500 to 600°C, starting the decomposition at 135 to 300°C; the 6-coordination compound starts to decompose between 75 and 100°C. The infrared spectra revealed the presence of the carbonyl group of urea in all compounds: the highest frequency did not exceed 1640 cm^{-1} which is characteristic for the carbamide coordinated by means of the Me–O bond. (TTT)

18648 THE MECHANISM OF ELECTROLYTIC HYDROGEN EVOLUTION—EVIDENCE FOR THE PARTICIPATION OF PROTON TUNNELING. Bockris, J. O'M.; Matthews, D. B. (Univ. of Pennsylvania, Philadelphia). Electrochim. Acta, 11: 143-62(Feb. 1966).

The protium-tritium separation factor $S_{H,T}$ for hydrogen evolution was measured as a function of potential, temperature, and solution composition on Hg in acid solution. Tafel measurements and determination of the activation energy for hydrogen evolution on Hg were also carried out. The protium-tritium separation factor was found to be linearly dependent on potential for temperatures in the range from +50 to −71°C. At 27°C in 7.5N HCl the linear region extended from −0.8 to −1.3 v overpotential with a flattening out at high cathodic overpotentials to a value of $S_{H,T} = 3.4$. The rate of decrease of $S_{H,T}$ with increase in cathodic overpotential is given by $dS_{H,T}/d\eta = 10.0\ v^{-1}$ for 7.5N HCl and $dS_{H,T}/d\eta = 8.5\ v^{-1}$ for dilute H_2SO_4. Tafel data was obtained for 7.5N HCl in the region from −10 to −71°C and data for the dependence of i_0 on temperature was obtained in this region. The strong dependence of $S_{H,T}$ on potential is ascribed to the effects of proton tunneling. An anomalous dependence of Tafel slope and i_0 on temperature at temperatures below 5°C in 7.5N HCl is ascribed to specific adsorption of Cl^- ions. (auth)

18649 SYNTHETIC CHEMICAL ELEMENTS. Dominguez, G. Energ. Nucl. (Madrid), 9: 437-50(Nov.-Dec. 1965). (In Spanish).

A bibliographic review is presented of the historical evolution of the concept of elements and their atomic number. The artificial elements created and the reasons for the scientific interest in them are described. The methods in which these synthetic elements can be produced are discussed. The chemical aspects of the artificial elements (their position in the periodic table and their chemical preparation) are considered. (J.S.R.)

18650 ELECTROMETRIC STUDIES ON THE REACTION BETWEEN THORIUM AND ALKALI TUNGSTATE. Saxena, R. S.; Sharma, O. P. (Malaviya Regional Engineering Coll., Jaipur, India. Government Coll., Kota, India). Experientia, 22: 104-5(1966).

The reactions between thorium and tungstate ions were investigated amperometrically, and those between thorium nitrates and sodium tungstates were determined by pH and conductometric titrations. Electrometrically it was determined that between pH 4.50 and 5.75, normal thorium tungstate yields $ThO_2 \cdot 2\ WO_3$. (tr-auth)

18651 EQUILIBRIUM SPECIFIC ACTIVITY RELATIONSHIPS IN TWO-COMPARTMENT EXCHANGE SYSTEMS. Patten, Bernard C. (Oak Ridge National Lab., Tenn.). Health Phys., 12: 521-4(Apr. 1966). (ORNL-P-805).

When an element consisting of a stable- and radioisotope equilibrates between two exchanging compartments of a closed system, the individual isotopes may attain equilibrium simultaneously with the total element. However, it is also possible that total element equilibrium may precede

equilibria of the radioisotope and stable element, in which case specific activities in the compartments are unequal when the system becomes stationary with respect to the total element. Subsequent equilibration of the stable and radioactive components involves a time lag during which estimates of radioactivity in the compartments will be erroneous if based on the assumption that specific activities are equal because the total element has equilibrated. (auth)

18652 THE PREPARATION AND SOME PROPERTIES OF YTTRIUM, DYSPROSIUM, AND YTTERBIUM ALKOXIDES. **Mazdiyasni, K. S.; Lynch, C. T.; Smith, J. S. (Wright-Patterson Air Force Base, Ohio). Inorg. Chem., 5: 341-6(Mar. 1966).**

Isopropoxides of yttrium, dysprosium, and ytterbium were prepared by treating the metals with isopropyl alcohol using mercuric chloride as a catalyst. The reactants were refluxed for 24 hr at 82°C, and the isopropoxides were recrystallized from isopropyl alcohol. The use of stoichiometric amounts of mercuric chloride resulted in chloride contamination and alkene alkoxide formation. High-purity isopropoxides of these metals could not be made by the metal chloride–ammonia method commonly employed to make group IV-B transition metal alkoxides. Heavier alkoxides were made by an alcoholysis reaction of the isopropoxides with the appropriate higher boiling alcohol in benzene. Compounds prepared by alcoholysis methods included the 2-pentoxides of yttrium, dysprosium, and ytterbium and yttrium t-butoxide, 3-methyl-2-butoxide, 2-hexoxide, 3-ethyl-3-pentoxide, 3-hexoxide, 2-ethyl-1-hexoxide, and phenoxide. All the alkoxides were solids that sublimed or decomposed on melting at 200°C or higher. The alkoxides with heavier and branched-chain alkoxy groups were the most stable, but all differences were small and the chemistry was virtually identical for the three metals with the same alkoxy group attached. Thermal and hydrolytic decomposition was quantitative to the oxides. (auth)

18653 SPECTROPHOTOMETRIC STUDY OF TRIVALENT ACTINIDE COMPLEXES IN SOLUTION. I. URANIUM. **Shiloh, M.; Marcus, Y. (Soreq Nuclear Research Center, Yavne, Israel). Israel J. Chem., 3: 123-31(Dec. 1965)**

Spectra of uranium(III) were obtained in sulfuric acid, lithium chloride, and lithium bromide solutions. Intense bands at 18380 and 18280 cm^{-1} for concentrated chloride and bromide solutions, respectively, are attributed to 5f-6d transitions due to the UX^{2+} species. The stability constant of this complex, or contact-ion-pair, was calculated $\beta_1 = (1.3 \pm 0.3)10^{-3}M^{-1}$ for chloride and $(1.1 \pm 0.2)10^{-4}M^{-1}$ for bromide. These values for the stability constants were lower than those obtained by other methods for the solvent-shared-ion pair. (auth)

18654 SYNTHESIS AND SOME PHYSICOCHEMICAL PROPERTIES OF SINGLE CRYSTALS OF RARE EARTH CHROMITES. **Shevchenko, A. V.; Lopato, L. M.; Tresvyatskii, S. G. (Inst. of Problems of the Study of Materials, Kiev). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1945-8(Nov. 1965). (In Russian).**

Growing single crystals of rare earth chromites from fluxed melts was studied because of the earlier reported unsuccessful attempts to obtain the single crystals by this technique. Experiments are described, in which PbO and PbF_2, PbO and B_2O_3 mixtures, and Bi_2O_3 were used as solvents for the powdered chromites which were synthesized from pure rare earths and chromium nitrate. The R_2O_3/Cr_2O_3 ratio in the starting mixture, the oxides/solvent ratio, and temperature of dissolution were the main variables of the growth process. Exclusive formation of single crystals of the thirteen rare earth chromites of the perovskite-type structure was established only in the $PbO + PbF_2$ melt under optimized conditions. The perovskite structure was obtained regardless of whether the R_2O_3/Cr_2O_3 ratio corresponded to the stoichiometric composition of perovskite or garnet. At a maximum temperature of dissolution above the optimum (1360°C) in the $PbO + PbF_2$ melt and in $PbO + B_2O_3$ and Bi_2O_3 melts, formation of chromium oxide single crystals was observed in addition to that of perovskite. The single crystals of the rare earth chromites had $2 \times 2 \times 2$ mm maximum dimensions. Infrared spectra, x-ray, and petrographic analysis of the crystals indicated that the rare earth chromites begin to dissociate at 2100°C in argon and that thermal dissociation increases with decreasing ionic radius of the rare earth element. (CFSTI)

18655 THERMAL DENITRATION OF URANYL NITRATE HEXAHYDRATE. **Ondrejcin, R. S. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. J. Chem. Eng. Data, 11: 130-3(Jan. 1966).**

The thermal decomposition of uranyl nitrate hexahydrate was studied in the temperature range of 250 to 400°C at atmospheric and at <0.1-mm pressure. The intermediate and final products of the decomposition were determined. The denitration followed a zero-order reaction until less than half of the uranyl nitrate remained. The specific reaction rate constants were measured for denitration, and from these data the heats and entropies of activation were calculated. (auth)

18656 QUANTUM STATISTICAL MECHANICS OF ISOTOPE EFFECTS. II. THE SURFACE TENSION AND INTERNAL ENERGY. **Deutch, J. M.; Kinsey, J. L.; Oppenheim, I. (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 44: 2270-6(Mar. 15, 1966).**

The thermodynamic properties of a system with given intermolecular potential, including first quantum corrections, are shown to be identical to those for a classical system with an effective intermolecular potential. This technique, together with a statistical-thermodynamic derivation of a molecular expression for the surface tension, enables the classical and first-quantum-corrected surface tension to be calculated. The first quantum corrections are utilized to discuss the difference in the thermodynamic properties of isotopes. The agreement between the experimental and theoretical difference in surface tension of H_2 and D_2 is excellent. It was found that the major difference is due to the difference in density along the vapor-liquid equilibrium line. The effect is similar though not as pronounced in the case of the energy of vaporization. (auth)

18657 ION-MOLECULE REACTIONS BETWEEN H_3^+ AND SATURATED HYDROCARBONS. **Aquilanti, V.; Volpi, G. G. (Univ., Rome). J. Chem. Phys., 44: 2307-13 (Mar. 15, 1966).**

The ion-molecule reactions of H_3^+ and D_3^+ with methane, ethane, propane, isobutane, and n-butane were studied by high-pressure mass spectrometry, using an ion source which employs the beta rays of tritium as the ionizing medium. The rate constants were measured, and proton transfer was found to be the major mode of interaction. If not stabilized by collision, protonated methane and protonated ethane decompose by elimination of hydrogen, with a lifetime of the order of 1 and 10^{-1} μsec, respectively. Protonated propane and protonated butanes, which were not detected as stable species at pressures as high as 0.3 torr, decomposed by elimination of hydrogen or a smaller saturated hydrocarbon to give an alkyl carbonium ion. Some results concerning the reactivity of these alkyl ions with deuterium and the hydrocarbons are also reported. (auth)

18658 ISOTOPE EFFECTS ON FRANCK–CONDON FACTORS. V. ELECTRONIC TRANSITIONS OF ISOTOPIC O_2, N_2, C_2, AND H_2 MOLECULES. **Halmann, M.; Laulicht, I. (Weizmann Inst. of Science, Rehovoth, Israel). J. Chem. Phys., 44: 2398-2405(Mar. 15, 1966).**

Arrays of Franck–Condon factors for vibrational quantum numbers up to v' and $v'' = 14$ were computed using Morse potentials, for the Schumann–Runge bands of $^{16}O_2$, $^{16}O^{18}O$, and $^{18}O_2$, for the first positive and the Vegard–Kaplan band systems of $^{14}N_2$ and $^{14}N^{15}N$, for the Swan bands of $^{12}C_2$ and $^{12}C^{13}C$, and for the Lyman bands of H_2 and D_2. The isotope effects on vibrational transition probabilities were large at the minima between the loci of the Franck–Condon parabolas and smallest at the loci of the maxima. (auth)

18659 ISOTOPE EFFECTS ON FRANCK–CONDON FACTORS. VI. PRESSURE-BROADENED ABSORPTION INTENSITIES OF THE SCHUMANN–RUNGE BANDS OF $^{16}O_2$ AND $^{18}O_2$. Halmann, M. (Weizmann Inst. of Sciences, Rehovoth, Israel). J. Chem. Phys., 44: 2406-8 (Mar. 15, 1966).

Integrated absorption intensities of the Schumann–Runge bands of gaseous $^{16}O_2$ and $^{18}O_2$ were measured, using pressure broadening by argon. For the (2,0) to (6,0) bands, the observed isotope effect on band intensities was equal to the calculated isotope effect on Franck–Condon factors. For the (7,0) to (10,0) bands, deviations of the observed isotope effect from that computed may be due to failure of the Morse potential function used in the computations, or to experimental difficulties caused by overlapping of bands. (auth)

18660 NEUTRON AND INFRARED SPECTRA OF $HCrO_2$ AND $DCrO_2$. Rush, J. J. (National Bureau of Standards, Washington, D. C. Argonne National Lab., Ill.); Ferraro, J. R. J. Chem. Phys., 44: 2496-8 (Mar. 15, 1966).

The vibrational spectra of $HCrO_2$ and $DCrO_2$ were investigated by the energy-gain scattering of cold neutrons, and by infrared absorption spectra from 4000–30 cm^{-1}. The infrared measurements were in agreement with previous results above 300 cm^{-1}. In addition, no absorptions were observed between 300 and 30 cm^{-1}, a region not covered in previous measurements. The results appeared to support previous evidence for asymmetric hydrogen bonds in $DCrO_2$ and essentially symmetric bonds in $HCrO_2$. The neutron spectra exhibited a number of maxima, including a band peaked at about 225 cm^{-1} in $HCrO_2$ (and a less intense peak around 180 cm^{-1} in $DCrO_2$), probably due to low-frequency optic lattice modes. A comparison of the neutron and infrared results appears to raise some uncertainty concerning the assumption of symmetric hydrogen bonds in $HCrO_2$. (auth)

18661 STRUCTURE OF CUBIC AMMONIUM FLUOSILICATE: NEUTRON-DIFFRACTION AND NEUTRON-INELASTIC-SCATTERING STUDIES. Schlemper, Elmer O. (Brookhaven National Lab., Upton, N. Y.); Hamilton, Walter C.; Rush, J. J. J. Chem. Phys., 44: 2499-2505 (Mar. 15, 1966). (BNL-9681).

The motion of the ammonium ion in the cubic phase of $(NH_4)_2SiF_6$ was investigated by the inelastic scattering of slow neutrons. The prominent feature of the neutron energy-gain spectrum was a moderately broad band peaked at 168 ± 8 cm^{-1} with a shoulder at 305 ± 25 cm^{-1}. These were assigned to the 1–0 and 2–0 transitions of a rotational motion of the ammonium ion. A precision refinement of single-crystal neutron-diffraction data was also completed. There was a well-defined disorder of the ammonium groups. Although a model with a static threefold disorder, with each ⅓ hydrogen atom undergoing harmonic vibration gave a very satisfactory fit to the data, such a model is probably unrealistic in view of the fact that the disordered positions were only 0.75 Å apart. A more realistic model was one involving an ordered hydrogen atom undergoing thermal motion in a very anharmonic potential well. A model is proposed in which the hydrogen atom is relatively free to move over a region of about 1 $Å^2$ by small rotations of the ammonium ion but with a very high barrier toward a reorientation which involves an interchange of two hydrogen atoms. Such a model is an agreement with both the neutron-diffraction and the inelastic-scattering data. The hydrogen-atom positions found in the diffraction study do not agree with those reported by Vainshtein on the basis of an analysis of the electron-diffraction data. The N–H bond length was not well defined because of the uncertainties regarding the thermal motion. An uncorrected mean atomic separation of 0.985 (σ = 0.007) was obtained; the actual bond length was about 0.08 Å longer. The SiF_6^{2-} ion was a regular octahedron with a corrected bond length Si–F = 1.696 (σ = 0.003). (auth)

18662 OXYGEN AND NITRIC OXIDE QUENCHING OF POSITRONIUM IN LIQUIDS. Lee, John; Celitans, G. J. (New England Inst. for Medical Research, Ridgefield, Conn.). J. Chem. Phys., 44: 2506-11 (Mar. 15, 1966).

The value of the long lifetime for positron annihilation in a number of organic liquids was markedly reduced by the presence of dissolved oxygen or nitric oxide. If the change in long lifetime is interpreted as a quenching reaction of triplet positronium formed in these liquids, the reaction with oxygen or nitric oxide was found to obey bimolecular kinetics with quenching rate constants in the range 10^{10}–$10^{11} M^{-1}sec^{-1}$, about twice those for oxygen quenching of molecular excited states in these same liquids. These reactions also exhibited the usual features of diffusion controlled reactions having inverse viscosity dependence and low activation energy. The interpretation of these and other properties of positronium in liquids was made by postulating solvent-cage trapping of the triplet positronium. These considerations severely limit the amount of information which may be obtained by study of these reactions in liquids. (auth)

18663 EFFECT OF OXYGEN, NITROGEN, AND WATER IN LOW-PRESSURE HYDROGEN DISCHARGES. Rony, Peter R.; Hanson, D. N. (Univ. of California, Berkeley). J. Chem. Phys., 44: 2536-8 (Mar. 15, 1966). (UCRL-16211).

Studies were made on the role of oxygen, nitrogen, and water in increasing the yield of atomic hydrogen from a low-pressure hydrogen discharge. The flow-tube system used is described. The results showed that the addition of small amounts of oxygen to pure hydrogen stoichiometrically increased the yield of atoms from the low-pressure 50-MHz discharge by a ratio of at least two atoms per molecule of oxygen. Molecular nitrogen had a similar but smaller effect, which started to saturate at low concentrations of nitrogen. On the other hand, the addition of small amounts of water had no effect on the yield of atoms from the low-pressure discharge. The Wrede-Harteck gage did not discriminate between atoms of hydrogen, oxygen, or nitrogen. Further tests led to the conclusion that water, at least in the apparatus and under the experimental conditions used, did not influence the yields of atomic hydrogen from the low-pressure discharges. (P.C.H.)

18664 FRANCK-CONDON FACTORS FOR THE IONIZATION OF H_2 AND D_2. Dunn, Gordon H. (Joint Inst. for Laboratory Astrophysics, Boulder, Colo.). J. Chem. Phys., 44: 2592-4 (Apr. 1, 1966).

Franck-Condon factors for ionization of $H_2(^1\Sigma_g^+)$ and $D_2(^1\Sigma_g^+)$ are presented for 19 levels in $H_2^+(^2\Sigma_g^+)$ and for 27 levels in $D_2^+(^2\Sigma_g^+)$. Comparisons were made with calculations, using less accurate potential functions for the molecular ion. Vibrational eigenenergies are given for D_2^+. (auth)

18665 LOW-TEMPERATURE TRANSPORT PROPERTIES OF GASEOUS H_2, D_2, AND HD. Diller, Dwain E.; Mason, E. A. (Univ. of Maryland, College Park). J. Chem. Phys., 44: 2604-9 (Apr. 1, 1966).

A complete quantal phase-shift calculation of the transport properties of gaseous H_2, D_2, HD, and some of their mixtures is presented from 10 to 300°K, based on the Lennard-Jones (12–6) potential. It was found that H_2 and D_2 have slightly different intermolecular potentials, in agreement with evidence from other sources. Agreement between calculation and experiment was generally good, but there were some indications that the (12–6) potential model is oversimplified, such as the necessity to use slightly different potential parameters for the transport properties than for the second virial coefficients. (auth)

18666 NONSTOICHIOMETRY IN URANIUM DIOXIDE. Thorn, R. J.; Winslow, G. H. (Argonne National Lab., Ill.). J. Chem. Phys., 44: 2632-43 (Apr. 1, 1966).

An extension of Anderson's formulation of the defect theory of nonstoichiometry was used with an oxygen-interstitial oxygen-vacancy model to calculate the composition of the uranium dioxide phase at the lower phase boundary and the relative partial molar thermodynamic functions for oxygen at compositions ranging from the lower phase boundary to $UO_{2.08}$. The model was used as a basis on which to argue that differing experimental re-

sults near $UO_{2.00}$ are more likely due to differing, non-equilibrium, concentrations of uranium vacancies than to failure to reach oxygen equilibrium. The present form of the model, with an interstitial site density of one per uranium site fails sharply at about $UO_{2.08}$ rather than gradually as the oxygen content is increased from $UO_{2.00}$. Discussion of the effects of alternate site densities is used to explain the observed values of the partial molar entropy of oxygen in the range from $UO_{2.02}$ to $UO_{2.24}$. (auth)

18667 REACTIONS OF CARBON ATOMS WITH N_2, H_2, AND D_2 AT 4.2 DEG K. Moll, Norman G.; Thompson, Warren E. (Case Inst. of Tech., Cleveland). J. Chem. Phys., 44: 2684-6(Apr. 1, 1966).

Photochemical decomposition of matrix-isolated carbon suboxide at 4.2°K with 1470-Å light produced highly reactive carbon atoms, presumably from an observed CCO intermediate. Reactions of carbon atoms with nitrogen led to the observation of the infrared absorptions of the NCN and CNN radicals. Attempts to form methylene in spectroscopically observable amounts by the reaction of carbon atoms with H_2 or D_2 in an argon matrix were unsuccessful, although its existence was inferred by the observed production of methane and ketene. (auth)

18668 EPR SPECTRA OF Gd^{3+}-DOPED $LaBr_3$ AND $La_2(SO_4)_3.9H_2O$. Johnston, D. R. (Univ. of California, Los Angeles); Wong, E. Y.; Stafsudd, O. M. J. Chem. Phys., 44: 2693-5(Apr. 1, 1966).

The EPR spectra of Gd^{3+}-doped $LaBr_3$ and $La_2(SO_4)_3 \cdot 9H_2O$ were measured in the X band at room, liquid-nitrogen, and liquid-helium temperatures. The zero-field splitting of the gadolinium ion is shown to have no obvious relation to the crystal-field parameters of the 4f configuration. (auth)

18669 HEAT CAPACITY AND OTHER THERMODYNAMIC PROPERTIES OF MoF_6 BETWEEN 4 DEG AND 350 DEG K. Osborne, Darrell W.; Schreiner, Felix; Malm, John G.; Selig, Henry; Rochester, Leon (Argonne National Lab., Ill.). J. Chem. Phys., 44: 2802-9(Apr. 1, 1966).

Thermodynamic properties of MoF_6 were measured between 4 and 350°K in order to obtain a third-law value of the entropy for comparison with the entropy calculated from molecular data. The enthalpy change for the solid-solid transition at 263.48 ± 0.02°K was 1953.3 ± 2.0 cal $mole^{-1}$, and the enthalpy of fusion at the triple point, 290.73 ± 0.02°K, was 1034.2 ± 1.0 cal $mole^{-1}$. The vapor pressure between 291 and 320°K is represented by the equation $\log_{10} P_{mm} = -2047.15/T - 4.28004 \log_{10} T + 20.19354$. At 298.15°K the enthalpy of vaporization calculated from the vapor-pressure equation and the measured second virial coefficient, –923 cm^3 $mole^{-1}$, was 6630 cal $mole^{-1}$. The standard entropy of the gas at 298.15°K obtained from the thermal data was 83.75 ± 0.10 cal deg^{-1} $mole^{-1}$. This agreed with the value of 83.77 cal deg^{-1} $mole^{-1}$ calculated from Nazarian's electron-diffraction measurement of the Mo–F distance (1.840 Å) and from Weinstock and Goodman's vibrational assignment. Thermodynamic functions were tabulated at selected temperatures. At 298.15°K the values of C_p°, S°, $(H^\circ - H_0^\circ)/T$, and $(G^\circ - H_0^\circ)/T$ were 40.58 ± 0.04, 62.06 ± 0.06, 34.23 ± 0.03, and –27.83 ± 0.03 cal deg^{-1} $mole^{-1}$, respectively, for liquid MoF_6 and 28.82, 83.77, 19.25, and –64.51 cal deg^{-1} $mole^{-1}$, respectively, for gaseous MoF_6. (auth)

18670 THE SOLUBILITY OF THE CHLORIDE ISOPROPYLATES OF CERIUM AND THORIUM IN ISOPROPYL ALCOHOL. Saad, M. A.; Soliman, H. T. (Faculty of Engineering, Alexandria, Egypt). J. Chem. UAR, 5: 21-7 (1962).

A method was developed for measurement of the solubilities of metal halides with alcohol of addition in non-aqueous solvents under anhydrous conditions. Cerous chloride isopropylate was prepared by azeotropic dehydration. Thorium chloride with isopropyl alcohol (iso-PrOH) of addition was prepared from anhydrous thorium tetrachloride and dry iso-PrOH, followed by several crystallizations from the alcohol. The solubility of $CeCl_3 \cdot 3$ iso-PrOH and $ThCl_4 \cdot 4$ iso-PrOH in isopropyl alcohol was measured in the range 27–65°C. The results showed that the rate of increase in solubility with temperature of $CeCl_3 \cdot 3$ iso-PrOH was higher than that of $ThCl_4 \cdot 4$ iso-PrOH. The relative solubilities of these compounds at the temperature of boiling alcohol were also determined. On plotting $\log_{10}$ solubility against temperature T°C for the cerium and thorium compounds, two straight lines were obtained which enabled an estimate, by extrapolation, of the solubilities at temperatures around the boiling point of the alcohol. It appeared that the solubility of cerium salt, at the boiling point of the alcohol, was about 2.5 times that of the thorium compound. These compounds had the same solubility at 19°C. (BBB)

18671 CERIUM AND THORIUM CHLORIDE ALCOHOLATES. Saad, M. A.; Soliman, H. T. (Faculty of Engineering, Alexandria, Egypt). J. Chem. UAR, 5: 29-40(1962).

Some cerium and thorium chloride alcoholates were prepared. These include $CeCl_3 \cdot 3ROH$, where R = Me, Et, iso-Pr, n-Pr, iso-Bu, and n-Bu, as well as $ThCl_4 \cdot 4R'OH$, where R′ = iso-Bu and n-Pr. Solubility determinations of some of these alcoholates in the corresponding alcohol were studied. The action of heat under reduced pressure on thorium chloride isopropylate and cerium chloride isopropylate, for the purpose of finding the best condition of drying, was also investigated. The results showed that cerous chloride with added alcohol conformed to the general composition $CeCl_3 \cdot 3ROH$ in which cerium shows a covalency of 6. Anhydrous cerous chloride was more difficult to prepare than the hydrated compound, so the latter was used as a starting material for the preparation of the alcoholates. Hydrated thorium chloride was dehydrated with thionyl chloride, which effectively dehydrated cerous chloride and provided a product which, although not pure, was anhydrous. The alcoholates prepared by the addition of the corresponding dry alcohol to the dehydrated cerous chloride were impure except the isopropyl alcoholate, which was crystallizable from PrOH. The possibility of preparing the alcoholates of cerous chloride from the hydrated trichloride was also explored and the ethyl, isopropyl, n-propyl, and n-butyl alcoholates of cerous chloride as well as the n-propyl and isobutyl alcoholates of thorium tetrachloride were prepared by azeotropic dehydration, benzene being used with the appropriate alcohol. While normal and isobutylates of cerous chloride were found to be insoluble in dry benzene, n-butylate, and isobutylate of thorium tetrachloride could be crystallized from benzene. (TCO)

18672 DEVELOPMENTS IN THE NUCLEAR MAGNETIC RESONANCE STUDY OF MOLECULAR MOTION IN SOLIDS. Andrew, Edward Raymond; Allen, Peter Sutcliffe (Univ. of Nottingham, Eng.). J. Chim. Phys., 63: 85-93 (Jan. 1966)

Progress during the past five years in applying the nuclear magnetic resonance method to the study of molecular motion in solids is reviewed. Examples of globular molecules include: perfluorocyclohexane, adamantane, hexamethylenetetramine, camphor, and hexamethylbenzene. Small molecular systems discussed include: hydrogen ions in metallic hydrides, solid hydrogen and deuterium, solid ^3He, ethylene, cyclobutane, cyclohexane, tetramethyl compounds, and simple tetrahedral and octahedral systems. The motion of water molecules was examined in hydrates, mineral crystals and fibrous materials along with the rotational motion of molecules encaged in clathrates or bound in solid complexes. Methyl group reorientation and molecular self-diffusion were reported in many compounds. Chemical shift fine structure was resolved in some solids whose spectra were strongly narrowed by rotational and diffusional motion, and was also obtained by the technique of macroscopic rotation. Long chain molecules, polymers, and solutes in liquid crystals are discussed. Developments both in experimental methods and in theoretical interpretation are briefly mentioned, and a section is given on molecular motion studied through quadrupole effects. (auth)

18673 TRACER STUDIES OF SELF DIFFUSION IN MOLECULAR SOLIDS. Hood, Gavin M.; Sherwood,

John N. (Univ. of Strathclyde, Glasgow). J. Chim. Phys., 63: 121-7(Jan. 1966).

The methods of measuring self-diffusion in organic molecular crystals using radio-tracer techniques are described. The results of these studies are compared with radio-tracer studies of inorganic molecular solids, and with the evidence for self-diffusion in organic solids obtained by nuclear magnetic resonance and electron spin resonance techniques. (41 references). (auth)

18674 SLOW NEUTRON STUDIES OF MOLECULAR MOTIONS IN CONDENSED MATTER. Palevsky, Harry (Brookhaven National Lab., Upton, N. Y.). J. Chim. Phys., 63: 157-67(Jan. 1966).

Fundamentals of the inelastic neutron scattering method are reviewed. Some examples of neutron measurements related to the motions of molecules in condensed matter and change of phase are discussed as illustrations of the neutron method. (auth)

18675 STUDY OF NON-STOICHIOMETRIC PHASES OBTAINED DURING REDUCTION OF U_3O_8 BY HYDROGEN. Murat, Michel; Chevreton, Maurice; Berodias, Gilbert; Eyraud, Charles (Faculte des Sciences, Lyon). J. Chim. Phys., 63: 325-31(Feb. 1966). (In French).

A series of semiconducting phases (between compositions $UO_{2.04}$ and $UO_{2.60}$) were previously described. The results were obtained by x-ray diffraction and electric conductivity measurements. Additional experiments were carried out. At low temperature ($T < 400°C$) mixtures of UO_{2+x} and U_3O_8 were obtained between compositions $UO_{2.25}$ and $UO_{2.60}$. The kinetics of reduction were slow. There was no formation of quadratic phases. At higher temperature, cubic oxides were obtained between the compositions $UO_{2.04}$ and $UO_{2.25}$. These solids showed generally a certain defect of homogeneity, which depended on the reduction temperature. (auth)

18676 DEPOSITION OF VARIOUS RADIOACTIVE ELEMENTS ON THE SURFACE OF A PLATINUM ANODE. IV. EFFECT OF THE HYDROGEN ION CONCENTRATION ON THE ANODIC DEPOSITION OF RADIOACTIVE ELEMENTS. Madi, I. (L. Kossuth Univ. of Sciences, Debrecen, Hungary). J. Inorg. Nucl. Chem., 28: 335-45(Feb. 1966).

Changes in the rate constant, equilibrium distribution coefficient, and in the number of active centers were studied as functions of the hydrogen ion concentration during the anodic deposition of ^{204}Tl, ^{144}Ce, ^{54}Mn, and ^{212}Pb. It was found that the distribution coefficient and the number of active centers change when the hydrogen ion concentration of the solution to be electrolyzed is altered, while the rate constant remains the same. The effect of adsorption on the kinetics of anodic deposition was interpreted with experimental data obtained by the determination of the activation energy characteristic of the anodic deposition of various radioactive elements, as well as on the basis of the experimental data obtained in the kinetic study of the adsorption of radioactive elements on the surface of anodically polarized and nonpolarized platinum. (auth)

18677 APPLICATION OF RADIOACTIVE ISOTOPES IN THE STUDY OF TRANSITION TEMPERATURE. I. Purkayastha, B. C.; Sarkar, Samir (Saha Inst. of Nuclear Physics, Calcutta). J. Inorg. Nucl. Chem., 28: 347-54 (Feb. 1966).

A method of determining the transition temperature of a component at tracer level in a mixed crystal forming system where the morphologically analogous host has a greater range of stability is described. It consists of measuring the homogeneous distribution factor, (D), of the host and the guest in question at different temperatures and plotting the results; the curve shows a prominent change at the transition point of the guest component. $FeSO_4 \cdot 7H_2O$ (monoclinic) and $MgSO_4 \cdot 7H_2O$ (orthorhombic) were used as hosts, and ^{60}Co and ^{65}Zn in sulfuric acid at tracer level as guests. Transition temperatures of monoclinic $CoSO_4 \cdot 7H_2O - 6H_2O$ and $ZnSO_4 \cdot 7H_2O - 6H_2O$ were found to be, respectively, $47 \pm 0.5°C$ and $25 \pm 0.5°C$. The transition temperature of orthorhombic $ZnSO_4 \cdot 7H_2O - 6H_2O$ found by this method is $39.5 \pm 0.5°C$. The values for these three systems agree fairly well with those determined by other methods. Thus radioactive isotopes can be used in this field of investigation in classical chemistry. The importance and application of this method of determining transition temperatures are discussed. (auth)

18678 THE LOWER SULFIDES OF HAFNIUM AT HIGH TEMPERATURE. Franzen, H. F.; Graham, J. (Ames Lab., Ames, Iowa). J. Inorg. Nucl. Chem., 28: 377-80(Feb. 1966). (IS-1008).

The compounds HfS and Hf_2S were prepared by high-temperature annealing. The symmetries and lattice parameters of these compounds were determined. (auth)

18679 THERMAL PROPERTIES OF SOME SOLID NEODYMIUM COMPLEXES DERIVED FROM ETHYLENE-DIAMINETETRAACETIC ACID. Charles, R. G. (Westinghouse Research Labs., Pittsburgh). J. Inorg. Nucl. Chem., 28: 407-14(Feb. 1966).

The dehydration and thermal decomposition of the compounds, $HNdEDTA \cdot H_2O$, $LiNdEDTA \cdot 4H_2O$, $NaNdEDTA \cdot 8H_2O$, $KNdEDTA \cdot 8H_2O$, $RbNdEDTA \cdot 5H_2O$, and $CsNdEDTA \cdot 4H_2O$, were studied by means of thermogravimetric analysis, differential thermal analysis, and thermomanometric analysis. The alkali metal salts dehydrated to the anhydrous compounds, which decomposed abruptly in the temperature region from 350 to 400°C. The parent acid $HNdEDTA \cdot H_2O$ could not be dehydrated without decomposition of the organic portion of the complex. (auth)

18680 THERMAL DECOMPOSITION OF NEODYMIUM OXALATE AND CHANGES IN SURFACE AREAS OF THE PRODUCTS. Subba Rao, V. V.; Rao, R. V. G.; Biswas, A. B. (National Chemical Lab., Poona). J. Inorg. Nucl. Chem., 28: 415-20(Feb. 1966).

The changes in surface area were studied when neodymium oxalate was heated in air in the range from 30 to 950°C. The products at each stage were also examined by determination of mass loss, density, infrared absorption, and by x-ray diffraction measurements. A plot of surface area vs temperature of calcination showed two maxima; the first, near 400°C, was due to the decomposition and disintegration of the oxalate, followed by a fall in area due to sintering (surface diffusion and adhesion), and the second, near 700°C, to the decomposition and combustion of the carbonaceous materials dispersed in the solid matrix in the intermediate steps. These were followed by a fall due to sintering by lattice diffusion in the bulk solid. (auth)

18681 THE CHEMISTRY OF PROTACTINIUM. VII. THE FLUORO-COMPLEXES. Bukhsh, M. N.; Flegenheimer, J.; Hall, F. M.; Maddock, A. G.; De Miranda, C. Ferreira (Chemical Lab., Cambridge, Eng.). J. Inorg. Nucl. Chem., 28: 421-31(Feb. 1966).

Ion-exchange and conductometric titration experiments suggested the existence of the PaF_8^{3-} anion. Pure samples of K_2PaF_7 and Na_3PaF_8 were prepared and analyzed. The salt $KPaF_6$ was made, but a completely pure product could not be obtained from solution. Some observations were made on the NMR and infrared spectra of the three complexes. Using an electrochemical method a preliminary set of values for the successive complexing constants k_{1-6} for the protactinium fluoro-complexes was obtained. (auth)

18682 STUDIES ON TTA COMPLEXES WITH METAL IONS. III. INVESTIGATIONS OF URANYL–TTA COMPLEX IN THE SOLID STATE. Baskin, Y.; Prasad, N. S. Krishna (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 28: 461-6(Feb. 1966).

Single crystals of the uranyl-TTA complex ($UO_2T_2 \cdot 2H_2O$) were prepared by recrystallization from benzene solution. Crystallographic, x-ray powder diffraction, chemical, and optical data are presented for the compound. Studies were also conducted of its infrared absorption and differential thermal analysis curves. (auth)

18683 A FLUORESCENT TERBIUM CHELATE SYSTEM IN WATER SOLUTION. Charles, R. G.; Riedel, E. P. (Westinghouse Research Labs., Pittsburgh). J. Inorg. Nucl. Chem., 28: 527-36(Feb. 1966).

The terbium ethylenediaminetetraacetate anion forms a 1:1 mixed ligand complex with the trivalent anion de-

rived from 5-sulfosalicyclic acid. Ultraviolet radiation absorbed by the organic portion of the mixed complex was efficiently converted to the green fluorescence characteristic of Tb^{3+}. Quantum efficiency for conversion was greater in D_2O than in H_2O solution and was essentially unity in the former solvent at room temperature. The corresponding mixed complex derived from europium ethylenediaminetetraacetate did not fluoresce. (auth)

18684 URANYL CHLORIDE COMPLEXES OF PYRIDINE-N-OXIDE AND 4-SUBSTITUTED PYRIDINE-N-OXIDES: INFRARED SPECTRA, ELECTRONIC SPECTRA, AND MAGNETIC SUSCEPTIBILITY STUDIES. Balakrishnan, P. V.; Patil, S. K.; Venkatasetty, H. V. (Atomic Energy Establishment, Bombay). J. Inorg. Nucl. Chem., 28: 537-41(Feb. 1966).

Uranyl chloride complexes of pyridine-N-oxide and 4-substituted pyridine-N-oxides were prepared and investigated by infrared spectra, electronic spectra, molar conductivity, and magnetic susceptibility measurements. All these complexes were found to be weakly diamagnetic. Attempts were made to correlate the changes observed as a function of the substituent in the characteristic N^+-O^- stretching frequencies of the complexes with the pK_α values and the Hammett sigma functions of the ligands. The electronic spectra supported the findings of the vibrational spectra that the metal–ligand bond formation takes place by the donation of the lone pair of p-electrons on oxygen of the NO group to the metal atom orbitals. The conductivity measurements showed that the complexes are six coordination compounds. (auth)

18685 ANION-EXCHANGE BEHAVIOR OF THE ALKALINE EARTH METALS. Bennett, Wm. E.; Skovlin, D. O. (Univ. of Iowa, Iowa City). J. Inorg. Nucl. Chem., 28: 591-8(Feb. 1966).

The anion-exchange behavior of complexes of magnesium, calcium, strontium, and barium with 2,6-pyridinedicarboxylic acid was related to the formation constants of the complexes. The results were found to be consistent with the concept that the metal is absorbed by the resin in the form (MA_3^{4-}). (auth)

18686 A RADIOCHEMICAL STUDY OF CATIONIC SELF-DIFFUSION IN SYNTHETIC ZEOLITES. Dyer, A.; Fawcett, J. M. (Royal Coll. of Advanced Tech., Salford, Eng.). J. Inorg. Nucl. Chem., 28: 615-28(Feb. 1966).

The kinetics of self-diffusion of the migration of Ca^{2+} and Sr^{2+} ions into Linde Molecular Sieve A, and of Ca^{2+}, Sr^{2+}, and Ba^{2+} ions into Linde Molecular Sieve 13X, were studied by a radiochemical method. Energy barriers against the self-diffusion processes were assessed from the Arrhenius equation ($D^* = D_0 \exp(-E/RT)$). Entropies and free energies of activation were calculated, and the values obtained compared with those obtained by conductivity techniques. The migration of Ca^{2+}, Sr^{2+}, and Ba^{2+} ions into several zeolite frameworks is discussed and their similarities to ionic migrations in electrolytes are considered. (auth)

18687 MICELLE FORMATION AND HYDROPHOBIC BONDING IN DEUTERIUM OXIDE. Mukerjee, Pasupati; Kapauan, Paz; Meyer, Herbert G. (Univ. of Southern California, Los Angeles. Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 70: 783-6(Mar. 1966). (BNL-9491).

The critical micelle concentrations of sodium decyl and lauryl sulfates at 25°C were determined from precise conductance data in water and in heavy water. The critical concentrations in heavy water were slightly lower (by about 2.5%). The solubility of sodium lauryl sulfate at 9°C was about 5% lower in heavy water. The conductances of both small ions and micelles approximately followed Walden's rule. The interpretation of the solubility and the critical concentration data led to somewhat conflicting estimates regarding the relative strength of hydrophobic bonding in the two media; the difference in either case appeared to be small. It is suggested that this result may be misleading because of compensating effects of dimerization of the long-chain ions. (auth)

18688 REACTION OF HYDROGEN WITH BERYLLIUM OXIDE. Low, M. J. D.; Ramasubramanian, N. (Rutgers Univ., New Brunswick, N. J.). J. Phys. Chem., 70: 933-4(Mar. 1966).

Experiments on hydrogen sorption by BeO at various degassing conditions, pressures, and temperatures are discussed. Hydrogen uptake was not observed below 300°C, and, at 300 to 500°C, the hydrogen sorption by any one sample was not reproducible. On alternately exposing BeO to hydrogen and degassing at 500°C, it was found that the amounts of hydrogen taken up declined with each successive exposure by about 27%. This effect and the effects of oxygen are considered. Infrared bands of hydrogen and hydroxyl species were not observed, but bands of water adsorbed on the surface of BeO were observed. (F.J.H.)

18689 VAPOR PRESSURES OF SOLUTIONS OF EUROPIUM AND YTTERBIUM IN LIQUID AMMONIA—EVIDENCE OF HEXAAMMONIATES. Thompson, D. S.; Stone, M. J.; Waugh, J. S. (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem., 70: 934-5(Mar. 1966).

The composition dependence of the vapor pressure of ammonia over solutions of both europium and ytterbium metals in liquid ammonia was investigated at −75.9°C. Both metals appeared to form hexaammoniates on gradual removal of ammonia from europium and ytterbium solutions, it was observed that the solutions turned from deep blue to bronze in color as the ratio of metal to ammonia increased. The value of n in the formula $M(NH_3)_n$ was obtained by extrapolation to zero pressure. The values of n obtained for europium and ytterbium solutions are, respectively, 6.3 and 6.4. The bronze-colored solid had the approximate composition $M(NH_3)_6$ where M was either europium or ytterbium. On warming to room temperature ammonia was given off and gray residues remained. (F.J.H.)

18690 SOLVENT EFFECTS IN ISOTOPE EXCHANGE REACTIONS. IV. THE EFFECT OF NITRO COMPOUNDS ON THE EXCHANGE OF IODINE. Koroes, Endre; Ladanyi, Laszlo; Orban, Miklos; Pataki, Laszlo (Eoetvoes Lorand Tudomanyegyetem Szervetlen- es Analitikai-Kemiai Tanszeke, Budapest). Magyar Kem. Foly., 71: 546-50(Dec. 1965). (In Hungarian).

Nitro compounds accelerated the exchange of iodine between elementary iodine and 1-phenyl-2,3-dimethyl-4-iodopyrazolone. Logarithms of the half times of the exchange reactions plotted against the concentration of the nitro compounds dissolved in various solvents (C_6H_6, $CHCl_3$, CCl_4 and C_2H_5OH) gave straight lines. The "accelerating coefficient," (ϑ), was introduced, allowing characterization of the accelerating effect of various nitro compounds. The weaker the interaction between iodine and the solvent, the greater is ϑ for a given nitro compound. A relation was observed between the extent of acceleration and the dipole moment of the nitro compound. (auth)

18691 INVESTIGATIONS ON ELECTROLYTIC URANIUM DEPOSITION ON METALS. II. Pfeifer, V.; Bildstein, H. (Reaktorzentrums, Seibersdorf, Austria). Mikrochim. Ichnoanal. Acta, No. 5-6, 822-9(Dec. 1965). (In German).

The use of ammonium fluoride as electrolyte in the production of thin layers of uranium oxide on steel, aluminum, and other metals is described. Studies revealed the dependence of the deposition of the uranium on electrolyte concentration, acidity, and volume. The time required depended on the concentration of ammonium fluoride but could be reduced by stirring using the anode itself. The deposition of the uranium was quantitative up to layer thicknesses of ~0.5 mg U/cm², but preparations up to 1 mg U/cm² and 6 cm² can be prepared. (auth)

18692 A TECHNIQUE FOR PRODUCING DEUTERATED POLYETHYLENE TARGETS. Arnison, G. T. J. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Nucl. Instrum. Methods, 40: 359(Mar. 1966).

A method is briefly described for making deuterated polyethylene targets in the thickness range of 1 to 20 mg/cm². The material efficiency of the method is 95%. (L.B.S.)

18693 KINETICS OF THE REACTION OF OXIDATION OF U(IV) IONS BY Fe(III) IONS IN SULFURIC ACID SOLUTIONS. Minc, Stefan; Sobkowski, Jerzy; Stok, Miroslawa (Warsaw Univ.). Nukleonika, 10: 747-52 (1965).

Measurements of the course of the reaction between U(IV) and Fe(III) ions were carried out. The reaction rate rose as the sulfate ion concentration was increased and hydrogen ion concentration decreased. The temperature effect was also investigated. (auth)

18694 COMPLEXES OF URANYL SALTS WITH UREA AND SOME OF ITS ALKYL DERIVATIVES. Deptula, Andrzej (Inst. of Nuclear Research, Warsaw). Nukleonika, 10: 765-76(1965).

Thirty-nine solid complexes of uranyl nitrate, chloride, sulfate, oxalate, and perchlorate with urea, methyl urea, 1,3-dimethylurea, tetramethylurea, ethylurea, and 1,3-diethylurea were prepared. It was found that the density of these compounds decreases with the number of ligands and their molar volume. (auth)

18695 EXCHANGE REACTIONS BETWEEN POTASSIUM BROMIDE AND BROMINE VAPOUR. Barr, L. W.; Dawson, D. K. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Proc. Brit. Ceram. Soc., No. 5, 77-84(Dec. 1965).

Experiments on isotope exchange between potassium bromide and bromine vapor are described. The bromine isotope used, ^{82}Br, is produced in the solid by neutron irradiation. A description is given of the experimental techniques employed and the results obtained in studies of surface exchange and diffusion in KBr. (auth)

18696 DETERMINATION OF THE FREE ENERGY OF FORMATION OF COMPOUNDS USING THE EUTONIC METHOD. Filippov, V. K. Radiokhimiya, 7: 449-53 (1965). (In Russian).

A method for the calculation of the free energy of formation of compounds is proposed, based on determination of the chemical potentials of the components on the solubility isotherm in ternary systems. The free energy of formation of compounds in the system $CsNO_3-UO_2(NO_3)_2-H_2O$ was determined at 25°C. (tr-auth)

18697 MIXED PHASES OF PRASEODYMIUM(III) OXIDE AND TERBIUM(III) OXIDE. Brauer, G.; Pfeiffer, B. (Univ., Freiburg i. B.). Z. Anorg. Allg. Chem., 341: 237-43(Dec. 1965). (In German).

Mixed phases occurring in the $Pr_2O_3-Tb_2O_3$ system are dependent on temperature. At 550°C there is a complete series of mixed crystals with the C-type structure. From 900 to 1600°C, phases with the A, B, and C structure types were found, as well as two-phase regions. The B-type terbium sesquioxide, in an atmosphere of hydrogen, could be observed even at the relatively low temperature of 1600°C. (auth)

18698 ON THE PRECIPITATION OF URANIUM NITRIDES FROM URANIUM CHLORIDE SOLUTIONS IN IONIC MELTS. Naumann, D.; Tschirne, G.; Burk, W. (Zentralinstitut fuer Kernforschung, Dresden). Z. Chem., 5: 427(Nov. 1965). (In German).

Sublimed UCl_4 was led into a molten equimolar NaCl–KCl mixture which had been freed of H_2O by treatment with HCl at 900°C, followed by Ar. Ammonia was dried and freed of O_2. Precipitations were carried out by reaction of NH_3 with the melt between 700 and 1200°C. The precipitated nitride gave reproducible x-ray diffraction data; comparison of the lattice constants with the known values for U_2N_3 and UN_2 allowed calculation of the U : N ratio. At temperatures above 1000°C complete decomposition of the NH_3 in the melt occurred, and control of the reaction was permitted by analysis of the HCl effluent. It was thus found that precipitation occurs at a slower rate than decomposition; reduction to a ratio U : Cl = 1 : 3 occurred before precipitation of the nitride. In the temperature range between 700 and 950°C a finely crystalline powder was obtained whose composition ranged between $UN_{1.70}$ and $UN_{1.5}$. With increasing temperature less N was incorporated. At temperatures between 1000 and 1200°C a coarsely crystalline nitride was obtained. A small amount of Cl remained in precipitated nitride samples. (BBB)

18699 EUROPIUM TRICYCLOPENTADIENIDE. Tsutsui, Minoru; Takino, Toshio; Lorenz, Donald (New York Univ., New York). Z. Naturforsch., 21b: 1-2(Jan. 1966).

Europium tricyclopentadienide was prepared by the reaction of dichloroeuropium cyclopentadienide with two equivalents of sodium dicyclopentadienide as well as by the reaction of europium trichloride with three equivalents of sodium cyclopentadienide, both reactions taking place in tetrahydrofuran. It is stable in vacuum at temperatures up to 70°C. (auth)

18700 VIBRATIONAL SPECTROSCOPIC INVESTIGATIONS OF INORGANIC SOLIDS. XIV. IR SPECTRA OF CRYSTALLINE ANHYDROUS PERMANGANATE, PERTECHNETATE, AND PERRHENATE. Mueller, Achim; Krebs, Bernt (Univ., Goettingen, Ger.). Z. Naturforsch., 21b: 3-7(Jan. 1966). (In German).

The infrared absorption frequencies in the region of the $MeO_4^{\ominus}$ fundamental vibrations are reported for several crystalline permanganates, pertechnetates, and perrhenates. On the basis of the IR spectra of the crystals and of additional considerations correct frequencies were assigned to the $\nu_2(E)$ vibrations of the $MeO_4^{\ominus}$ tetrahedra. The influence of the crystal field on the fundamental vibrations of the $MnO_4^{\ominus}$, $TcO_4^{\ominus}$, and $ReO_4^{\ominus}$ ions is discussed, using site group analysis and factor group considerations. (auth)

18701 KINETIC STUDIES OF MODERATELY RAPID ISOTOPIC EXCHANGE REACTIONS. COMMENT ON THE "INTEGRAL METHOD." Beronius, Per (Royal Inst. of Tech., Stockholm). Z. Phys. Chem. (Frankfurt), 47: 246-9(Nov. 1965).

The reaction rate was deduced and the choice of reaction time is discussed for the case of exchange between initially inactive halide ions and the organic reactant in labeled form. (J.S.R.)

18702 ON THE CARBURIZATION METHOD OF BORIDE PRODUCTION AND ON MOLYBDENUM BORIDE. Iskol'dskii, I. I.; Gorbunov, A. E. (All-Union Scientific Research Inst. of Solid Alloys, USSR). Zh. Prikl. Khim., 38: 1428-32(July 1965). (In Russian).

A method for continuous single-stage synthesis of metal borides by reduction with carbon of metal oxides and boric oxide was developed. In the experiments conducted to obtain molybdenum boride, commercial boric acid, molybdenum anhydride containing 99% MoO_3, and lamp black were used. Mo_2B, α-MoB, β-MoB, and MoB_2 compounds were obtained by varying the content of B_2O_3 and carbon in the charge. The optimum molecular proportion of components in the initial charge for obtaining pure α-MoB was $2MoO_3 + 3B_2O_3 + 9C$. Molybdenum boride produced at a reaction temperature of 1800°C had the smallest total carbon content (0.32%C) and a boron content (9.44%) close to the stoichiometric. At higher or lower reaction temperatures the content of total carbon increased and that of boron decreased. The method was used successfully to obtain CrB, WB, ZrB_2, VB_2, MnB_2, TaB_2, TiB_2, and NbB_2. (CFSTI)

18703 CERIUM SELENIDES AND OXYSELENIDE. Obolonchik, V. A.; Mikhlina, T. M. Zh. Prikl. Khim., 38: 1451-6(July 1965). (In Russian).

Preparation of cerium selenides was studied. Two indirect methods were explored. The first reaction of pure cerium dioxide with pure selenium in the solid phase, produced, at 1100 to 1200°C and under specified conditions, nearly pure cerium oxyselenide Ce_2O_2Se. The data obtained at temperatures to 1350°C suggested that at even higher temperatures preparation of cerium selenide CeSe would be possible. Electric resistivity of compacted and slightly sintered Ce_2O_2Se samples was found to be of the order of 4×10^5 ohm · cm. The second method consisted of reacting pure cerium dioxide with hydrogen selenide. Nonstoichiometric cerium monoselenide was obtained by this reaction at 1100°C after 2 hr. At longer (5 to 6 hr)

reaction times and 1100 to 1200°C, a stoichiometric cerium selenide Ce_2Se_3 was obtained. The latter could be converted into CeS by heating in a hydrogen stream or in vacuum. (CFSTI)

18704 EVALUATION OF ALL POTENTIAL SOURCES OF ENERGY FOR DESALTING. Reichle, Leonard F. C. (Ebasco Services Inc., New York). 22p. (CONF-651005-3). ORAU. Gmelin, AED-CONF-65-276-5.

From 1st International Symposium on Water Desalination, Washington, D. C.

The alternate sources of fresh water are discussed; and it is concluded that with rising cost of obtaining additional supplies of fresh water, it is necessary to develop methods to remove contamination from brackish water or sea water to assure that the requirements for fresh water be met. Both major and minor sources of energy available for desalting are discussed and evaluated. Charts are presented to show various aspects of the use of the major sources of energy, fuel energy required by various desalting processes, etc. It is concluded that an established electric utility can produce the lowest cost electricity or steam for desalting, and charts and discussion are presented to show what kind of plant could best carry out the process. (B.L.M.)

18705 OBJECTIVES OF THE UNITED KINGDOM RESEARCH AND DEVELOPMENT PROGRAM FOR DESALINATION. Kronberger, H. (United Kingdom Atomic Energy Authority, Harwell, Eng.). 3p. (CONF-651005-2). ORAU. Gmelin, AED-CONF-65-276-4.

From 1st International Symposium on Water Desalination, Washington, D. C.

The present and immediately planned efforts of the U.K.A.E.A. in cooperation with industry in the desalination of water are briefly summarized. Various aspects of the multistage flash distillation process as well as related or supporting fundamental research studies currently underway are discussed. Designs of large combined desalination and nuclear power plants now being prepared are mentioned. Although the main effort is being devoted to the work on flash distillation, some alternative methods that are being studied are summarized. (B.L.M.)

18706 ANISOTROPY OF THE CHEMICAL SHIFT TENSOR FOR FLUORINES IN UF_6: APPLICATION TO THE FLUORINE ATOM MOVEMENT MODEL. Rigny, P. (Centre d'Etudes Nucleaires, Saclay, France). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-64/6, 24p. (In French). (CONF-650549-3). ORINS.

From IAEA Symposium on Exchange Reactions, Upton, N. Y.

R. Blinc et al. made an initial study of polycrystalline uranium hexafluoride using the magnetic resonance of fluorine at 40 Mcs. The low-temperature spectrum (t < 20°C) could be analyzed into a two-line superposition; this confirmed the structure found by x ray investigation in which, since the UF_6 octahedron has one long axis and two short axes, the fluorines are divided among two different types of site. The change in the spectrum with temperature (coalescence of the two lines) suggested movement of the fluorine atoms between the two types of site. By repeating these experiments at 56.4 and 94 Mcs, the existence of considerable axial anisotropy of the chemical shift tensor (about 650 ppM) was demonstrated. The absorption line obtained for a powder in these conditions is complex, a line-shape function f (h), which is the probability that a grain of powder is so oriented that it resonates for the value h of the field, was developed to study it. In the absence of movement (low temperature spectrum) the line-shape function for each of the two lines (corresponding to the two types of site) is of the form obtained for equivalent atoms. Since parameters of chemical shift tensors give information on chemical bond character, a considerable ionic character ($I \simeq \frac{1}{2}$) was attributed to the bonds between the uranium and the two most distant fluorines. In the presence of movement the line-shape function was different, and depended on the type of movement. For UF_6 study of the line-shape function in the case where there is a single line (t > 20°C) showed that the fluorine atoms are diffused throughout the crystal, each atom remaining in each of the different positions for about 5 μsec at 30°C. (auth)

18707 DEVICE FOR THE PRODUCTION OF PRACTICALLY PURE URANIUM DIOXIDE FROM URANIUM HEXAFLUORIDE. Ukaji, Rokuo; Wada, Hiroyuki (to Osaka Kinzoku Kogyo Co., Ltd.). German Patent 1,207,929. Dec. 30, 1965. Priority date Feb. 20, 1962, United States.

The device consists of a conical whirling chamber tapered downward to a point. It is provided with two separate inlet pipes at the upper end through which the reactants are injected tangentially into the whirling chamber. At the point of the chamber there is a receptacle for holding the uranium dioxide flowing out of the chamber. An annular exit channel for the remaining gases was obtained by locating a cylindrical partition coaxially in the upper portion of the whirling chamber. (Gmelin Inst.)

Organic Chemistry

Refer also to abstract 18935.

18708 PREPARATION OF ^{14}C LABELED CHLOROFORM AND METHYLENE CHLORIDE. Dobbs, H. E. (Atomic Energy Research Establishment, Wantage, Eng.). Atompraxis, 12: 83-5(Feb. 1966).

A method for the preparation of carbon-14-labeled chloroform from acetone-1,3-^{14}C and calcium hypochlorite is described. A refluxing solution of chloroform in dioxane is reduced to methylene chloride by addition of an aluminum lithium hydride slurry in dioxane. The active methylene chloride is removed from the system by distillation in order to prevent further reduction. The yield of redistilled methylene chloride (from chloroform) is 70%. (auth)

18709 SYNTHESIS OF 1-(P-HYDROXYPHENYL)-2-AMINO-ETHANOL-1-(1-^{14}C)-HYDROCHLORIDE. Schweer, K.-H. (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 12: 85-6(Feb. 1966). (In German).

The compound 1-(p-hydroxyphenyl)-2-aminoethanol can be obtained on a technical scale by a two-stage reaction. However, this reaction sequence is not suitable for labeling the compound with ^{14}C in the side-chain. For this reason, several methods for synthesizing the labeled substance were tested, one of which is described. (auth)

18710 DETERMINATION OF AGE BY LIQUID-SCINTILLATION-SPECTROMETRY. A NEW CATALYST FOR THE SYNTHESIS OF BENZENE. Pietig, F.; Scharpenseel, H. W. (Univ., Bonn). Atompraxis, 12: 95-7(Feb. 1966). (In German).

A method is described for a high-yield synthesis of benzene for radiocarbon dating. It is based on a commercially available catalyst, and converts acetylene gas into benzene with more than 90% efficiency. The acetylene is liberated from lithium carbide, incorporated by a chromate-activated cracking catalyst, and converted into benzene. Apart from its importance for ^{14}C dating this method opens new methods for production of ring-labeled aromatic compounds. (auth)

18711 ISOMERIZATION OF THE K VITAMINS. INCORPORATION OF TRITIUM IN PHYLLOQUINONE AND MENAQUINONE-I. Cohen, Paul; Mamont, Pierre; Azerad, Robert; Vilkas, Michel (Faculte des Sciences, Orsay, France). Compt. Rend., 261: 5144-7(Dec. 8, 1965). (In French).

Isomerization of phylloquinone(Ib) and of menaquinone-1 (Ia) in the presence of tritiated water led to the incorporation of tritium on the 3β carbon of the initial quinone. The dimer formed was strongly radioactive. (tr-auth)

18712 A NEW WAY TO REDUCE OXYGEN QUENCHING IN LIQUID SCINTILLATION SAMPLES. Mahin, D. T. (Walter Reed Army Inst. of Research, Washington, D. C.). Int. J. Appl. Radiat. Isotop., 17: 185-91(Mar. 1966).

While investigating the extent of oxygen quenching of samples in which radioactivity was tagged to the volatile solvent itself, a relatively simple method was found to displace oxygen from scintillation solutions without significant loss of radioactivity. Vials containing scintillation solution and tritiated toluene were frozen in liquid nitrogen. Then liquid nitrogen was poured onto the frozen contents and allowed to evaporate. The vials were then placed in

an alcohol bath at room temperature to warm. Freezing samples in liquid nitrogen was demonstrated to be a more effective method of gas displacement than gas bubbling and can be performed repeatedly, if desired, without significant loss of volatile radioactive solvent. (M.C.G.)

18713 THE HYDROGEN ISOTOPE EFFECT IN THE THERMAL DECOMPOSITION OF CYCLOBUTANE. Carr, Robert W. Jr.; Walters, W. D. (Univ. of Rochester, N. Y.). J. Amer. Chem. Soc., 88: 884-7(Mar. 5, 1966).

The thermal decomposition of mixtures of cyclobutane and cyclobutane-d_8 was studied at pressures from 100 to 0.005 mm at 449°C and over the temperature range from 419 to 460°C at pressures near 100 mm. The value of the isotope effect (K_H/K_D) for pressures in the neighborhood of 100 mm was observed to be 1.41 ± 0.02 at 449°C. The temperature dependence of the isotope effect near 100 mm could be expressed as $K_H/K_D = 0.75 \exp(900/RT)$. It was found that K_H/K_D decreases with decreasing initial pressure and reaches a value of unity near 0.08 mm at 449°C. At lower pressures an inverse isotope effect was observed, C_4H_8 reacting about 0.83 times as fast as C_4D_8 at 0.005 mm. (auth)

18714 BOND ENERGY EFFECTS AND ACETYLENE PRODUCTION IN THE REACTIONS OF ENERGETIC CARBON ATOMS WITH ALKYL HALIDES AND PROPANE. Ache, Hans J.; Wolf, Alfred P. (Brookhaven National Lab., Upton, N. Y.). J. Amer. Chem. Soc., 88: 888-93 (Mar. 5, 1966). (BNL-9469).

One of the products formed in the reactions between energetic carbon atoms and hydrocarbons or alkyl halides is acetylene. Eighty-five % or more of the acetylene-^{11}C produced from the specifically deuterated hydrocarbons $CD_3CH_2CH_3$, $CH_3CD_2CH_3$, and $CD_3CH_2CD_3$ or from the deuterated alkyl halides CD_3CH_2X and CH_3CD_2X by reaction with hot ^{11}C atoms ($^{14}N(p,\alpha)^{11}C$) is either isotopically pure $H^{11}C \equiv CH$ or $D^{11}C \equiv CD$. The deuterium label serves as a probe for the point of attack of the hot carbon atom. A regular increase in the proportion of the hot yield as acetylene from the $-CH_2X$ group, where X is CF_3, F, Cl, Br, and I, was noted. The increasing yield pattern was proportional to the decreasing bond dissociation energy, where the largest percentage of the hot products as acetylene was found to come from the $-CH_2I$ group. This further supported the "excitation-decomposition" mechanism in which the influence of "bond dissociation" energy on product formation was demonstrated for acetylene. In addition the ratio of acetylene production $[H^{11}C \equiv CH]_{CH_3}/[H^{11}C \equiv CH]_{CH_2}$ was ≅ 1.9/group for the compounds investigated. (auth)

18715 REACTION OF FREE CARBON ATOMS WITH CYCLOPENTADIENE. Rose, Timothy; MacKay, Colin; Wolfgang, Richard (Yale Univ., New Haven). J. Amer. Chem. Soc., 88: 1064-5(Mar. 5, 1966).

The interactions of free carbon atoms with gaseous cyclopentadiene were studied. Free carbon atoms were produced in the form of carbon-11 (20.5 min). The study was carried out to determine the fundamental mechanisms for carbon atom reactions. Yields of labeled-carbon-11 products from reactions of carbon-11 with cyclopentadiene are given. The yields of acetylene, diacetylene, and vinylacetylene dropped from two-thirds to one-third of the volatile activity on going from hot to thermalized carbon atoms. (F.J.H.)

18716 EVIDENCE FOR THE FORMATION AND REACTION OF METHYNE. Nicholas, John; MacKay, Colin; Wolfgang, Richard (Haverford Coll., Pa. Yale Univ., New Haven). J. Amer. Chem. Soc., 88: 1065-6(Mar. 5, 1966).

The apparent production of methyne (CH) by reaction of free carbon atoms with hydrogen and its reaction with ethylene are reported. Atomic carbon in the form of translationally excited (hot) carbon-11 was produced in mixtures of H_2 and C_2H_4. The volatile products produced from the reaction of hot carbon atoms with ethylene are given. The yield of the products is diminished as ethylene is diluted with hydrogen. The relative yields of C, CH, CH_2, CH_3, and CH_4 produced by reaction of C with H_2 in various mixtures of C with C_2H_4 were evaluated. The products were analyzed by gas chromatography. (F.J.H.)

18717 NEUTRON-SCATTERING STUDY OF HINDERED ROTATIONAL MOTIONS AND PHASE TRANSITIONS IN HEXAMETHYLBENZENE. Rush, J. J. (Argonne National Lab., Ill. National Bureau of Standards, Washington, D. C.); Taylor, T. I. J. Chem. Phys., 44: 2749-54(Apr. 1, 1966).

The low-frequency motions of solid hexamethylbenzene (HMB) were investigated above and below its λ transition near 110°K by the energy-gain scattering of cold neutrons. Measurements were also obtained above and below the high-temperature phase transition near 383°K. At temperatures below the λ point the neutron spectra exhibited a band peaked at 137 ± 5 cm^{-1}, which was assigned to the $1 \rightarrow 0$ transitions of the torsional oscillations of the methyl groups. Above the transition this band was broadened considerably and its maximum shifted down to 120 ± 5 cm^{-1}. These results showed that the λ transition is associated with a small change in the forces hindering rotation of the methyl groups. Assuming a simple threefold cosine potential for the methyl groups, the torsional peaks were used to calculate "average" barriers to rotation above and below the λ transition of 1.07 ± 0.09 and 1.35 ± 0.10 kcal/mole, respectively. These barriers were considerably lower than a recent estimate of 3 to 8 kcal/mole from thermodynamic results. Moreover, the torsional bands and calculated barriers were also significantly lower than those obtained recently by the neutron technique for the methyl groups in o-xylene and durene ($\nu_{tors} \simeq 170$ cm^{-1}, $V_3 \simeq 2$ kcal/mole). This indicated a considerable difference between the potential experienced by a methyl group surrounded by two other methyl groups on the benzene ring and that experienced by two adjacent groups. A second band with a maximum around 60 cm^{-1}, which showed little change at the λ transition, was also observed in the low-temperature spectra and attributed primarily to the over all librational motions of the HMB molecules. The spectra above and below the high-temperature transition showed only small changes with the change in phase. (auth)

18718 PYRIDOXINE CHEMISTRY. IX. SELECTIVELY DEUTERATED PYRIDOXOLS AND SOME ASPECTS OF NMR SPECTROSCOPY OF VITAMIN B_6 COMPOUNDS. Korytnyk, W.; Paul, B. (Roswell Park Memorial Inst., Buffalo). J. Heterocycl. Chem., 2: 481-5(Dec. 1965).

Synthesis of α^4-deuterated (I) and α^5-deuterated (II) pyridoxols was carried out as part of a study on the synthesis and biological activity of potential vitamin B_6 antimetabolites. Their synthesis is described as well as their application to studies of the NMR spectra of pyridoxol and its derivatives. Attempts to reduce the readily available 4-pyridoxic acid lactone (III) with lithium aluminum deuteride did not provide satisfactory results, as the yield of the desired compound was small. Acetylation of III, followed by reduction of the acetate (IV) with lithium aluminum deuteride, readily afforded I in 42% yield. II was obtained by lithium aluminum deuteride reduction of the methyl ester of α^4, 3-o-isopropylidene-5-pyridoxic acid (V). The structures of the compounds I, II, and VI was confirmed by mass spectrometry and also by NMR spectrometry. Both techniques indicated very high isotopic purity. This is exemplified by the NMR spectrum of α^4,3-o-isopropylidenepyridoxol-α^5, α^5-d_2 (VI), in which the 5-methylene peak has virtually disappeared. (TCO)

18719 TRITIATION OF PYRIMIDINES BY HTO IN THE PRESENCE OF ALUMINIUM CHLORIDE. Mantescu, C.; Genunche, A.; Balaban, A. T. (Inst. of Atomic Physics, Bucharest). J. Label. Compounds, 1: 178-81(July-Sept. 1965).

Pyrimidine derivatives (pyrimidine, 4,6-dichloropyrimidine, uracil, cytosine, and 4-chloro-6-hydroxypyrimidine) were tritiated at the ring by tritiated water in the presence of aluminum chloride in carbon disulfide or in ethylene dichloride (which is also tritiated under these conditions). (auth)

18720 THE CRITICAL SOLUTION TEMPERATURES OF SOME PHENOLS IN WATER AND DEUTERIUM OXIDE.

Schrier, Eugene E.; Loewinger, Robert J.; Diamond, Arthur H. (State Univ. of New York, Binghamton). J. Phys. Chem., 70: 586-8(Feb. 1966).

The upper critical solution temperature (ucst) values for m- and p-hydroxybenzaldehyde, and phenol were measured in H_2O and D_2O (with phenolic hydrogen exchanged for deuterium). The critical solution temperatures were measured in an open test tube using an accurate thermometer, which could be read to 0.03°C. The change in the excess free energy per mole of solution in going from H_2O to D_2O solutions was attributed to variations in the excess enthalpy, which was 4 cal more negative for the substituted phenols than for phenol. The order of magnitude of the isotope effects on the excess enthalpy was in good agreement with the values derived from the interpretation of the critical solution temperature data. While the ucst values of all the compounds were nearly the same in water, those of the substituted phenols were lowered relative to that of phenol-d in D_2O. (F.J.H.)

18721 THE SYNTHESIS OF GLUTAMIC ACID-(^{14}COOH). Falecki, J.; Plejewski, R. (Institut fuer Atomkernforschung, Warsaw). J. Prakt. Chem., 28: 123-8(1965). (In German).

Ethylene oxide was reacted with $H^{14}CN$ to yield cyanohydrin in a special apparatus at 18°C for 20 hr on a 4 to 10 mmole scale; this was hydrolyzed in aqueous HBr to yield 3-bromopropionic acid-^{14}COOH, which was purified by two sublimations in vacuo and crystallized from benzene. The yield was about 85%. The methyl ester was prepared from freshly sublimed acid with diazomethane in ether solution. After 5 hr at room temperature the excess solution was distilled off and the product dried at 100°C; the ester was stored in 3-ml ampoules. Separate procedures are given for condensation of the ester with phthalimidomalonic ester at the 20-mmole and the 3-mmole scale. Hydrolysis of this product in potassium hydroxide solution yields an intermediate, which was hydrolyzed in HCl to give the glutamic acid-^{14}COOH. Purification of this material was achieved with alkaline Amberlite IR-45 resin. The product was dissolved in water and precipitated with alcohol, yielding product of 98.5% purity based on pH-metric titration and containing a max of 1.2% NaCl. Total yield based on starting material is 20 to 25%. (BBB)

18722 EVALUATION OF INTERACTIONS OF PROTEIN SH GROUPS WITH DISULPHIDES BY MEANS OF A MODEL COMPOUND. Bitny-Szlachto, S. (Kaczkowski Military Inst. of Hygiene and Epidemiology, Warsaw). Progr. Biochem. Pharmacol., 1: 112-17(1965).

β-hydroxyethyl-2,4-dinitrophenyl disulfide (HEDD) was used as a model compound for the evaluation of potential biochemical recipients for the radioprotective and radiosensitizing compounds reacting with SH groups. HEDD, as well as its guanidine analog (the MEG derivative) reacts with thiols forming new mixed disulfides and 2,4-dinitrothiophenol. Results are reported from spectrophotometrical studies on the reaction kinetics of the SH components of glutathione, ovalbumin, and myosin with HEDD. (C.H.)

18723 SYNTHESES OF RADIOACTIVELY LABELED COMPOUNDS. XIII. COMMUNICATION 1. SYNTHESIS OF PEGENE-(9)(1,2,3,10-^{14}C)-DESOXYVASICINE. Johne, S.; Groeger, D. (Institut fuer Biochemie der Pflanzen, Deutsche Akademie der Wissenschaften, Halle/Saale, Ger.). Z. Chem., 6: 228-9(June 1965). (In German).

Proline labeled randomly (50.5 mg) and o-aminobenzaldehyde (52 mg) were dissolved in 20 ml water. To this 100 mg $NaIO_4 \cdot 3H_2O$ was added and the pH adjusted to 2 with acetic acid. This was shaken 2 days in the dark at 26°C. The orange solution was decomposed dropwise with $AgNO_3$ solution until no further precipitate formed. The precipitate was centrifuged off and the residue washed several times with distilled water. The solution was adjusted to pH 6 with NaOH and 150 mg of Mozingo 5% Pd/$BaSO_4$ catalyst was added. A stream of H_2 was introduced and the whole was heated 10 to 12 min to 100°C. The catalyst was removed by centrifugation. By colorimetry it was found that 55 mg of the alkaloid (77%) remained in solution. (BBB)

Radiation Chemistry

See also **BIOLOGY AND MEDICINE — Radiation Effects on Biochemicals Radiation Effects on Tissues**

18724 (BNL-10012) THE IONIZATION OF LIQUIDS UNDER RADIATION. Hummel, A.; Allen, A. O. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT(30-2)-Gen-16. 27p. (CONF-660508-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Symposium on Radiation Chemistry, Tihany, Hungary.

Radiation effects on ion mobilities in liquids were studied. The basic method used consisted of measurements of the limiting conductivity at zero voltage of an insulating liquid under irradiation. Using values determined for hexane, agreement was found to be better at low temperatures than at room temperature. It is also believed that low voltage measurements give the correct values, since extrapolation must always be somewhat uncertain. However, it is probable that extrapolation from high voltage measurements can give G correctly to within a factor of less than 2. Ethyl ether and 1,4-dioxane were also studied, and the effects of CCl_4 and tetrahydrofuran in hexane were considered. It was concluded that deviations from predictions based on the behavior of hexane, found in other liquids, may be attributed to differences in the rates of moderation of subexcitation electrons. (P.C.H.)

18725 (IS-T-73) EFFECT OF THE ^{58m}Co ISOMERIC TRANSITION IN TRIS(ETHYLENEDIAMINE) COBALT(III) NITRATE [Thesis]. Simpson, Daniel Lester (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 63p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The amount of ^{58}Co that was not retained by tris (ethylenediamine) cobalt(III) nitrate after the ^{58m}Co decay was determined. The compound was studied in solid state and in aqueous solutions. The amount of non-retention was determined to be 0.887 ± 0.097 and 0.518 ± 0.108 in solution and solid state, respectively. A model based on competitive reactions was postulated to explain the experimental results. (auth)

18726 (IS-T-74) RETENTION OF ^{126}I FOLLOWING PHOTONUCLEAR ACTIVATION IN POTASSIUM IODATE [Thesis]. Simpson, Suzanne Laatsch (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The retention of iodine in photonuclear activated potassium iodate was studied at dry ice temperature, room temperature, and 100°C. The samples were packed in dry ice during the irradiation, which lasted from 45 minutes to one hour. In order to separate the reduced form, the annealed sample was dissolved in water; and a carrier solution of iodine in ethanol was added. After a few minutes, the iodine was extracted with chloroform. The remaining iodate solution was diluted in a volumetric flask. The dry ice temperature annealing showed no change in retention over a period of 22 hours. At room temperature the retention increased from an initial value of 58.7 ± 0.96 to 73.9 ± 1.55% in two hours, and at 100°C the retention reached a value of 87.1 ± 1.04 in one hour. Estimated rate constants were $k_{RT} = 1\ hr^{-1}$, $k_{100} = 4\ hr^{-1}$. (auth)

18727 (JAERI-1100) RADIATION-INDUCED LIQUID-PHASE OXIDATION OF CUMENE. Yoshida, Kenzo; Kawakami, Waichiro; Sugo, Takanobu (Japan Atomic Energy Research Inst., Tokyo). Aug. 1965. 10p. (In Japanese). Dep. mn.

Liquid phase oxidation of cumene was carried out under ^{60}Co γ irradiation. Oxygen was bubbled into cumene in the reaction vessel at the rate of 1.5 l/min at 70°C. Reaction rates were estimated by the analysis of hydrogen peroxide in the sample which was drawn from the vessel at suitable intervals. At high dose rate (>10^4R/hr), reaction rate was

expressed in the formula $dx/dt = A\sqrt{a}$, or proportional to the square root of dose rate. In the induction period, $dx/dt \propto (ax)^{\frac{1}{2}}$ was obtained. The rate was also proportional to (hydrogen peroxide concentration)$^{\frac{1}{2}}$. Next, oxidation was carried out in the presence of a small quantity of NaOH. The rate at 70°C was increased from 10^{-6} mole/l·sec to 10^{-5} mol/l·sec. In this case, rate was described in the form $dx/dt = cx - mx^2$, and had no relation with dose rate. Finally, reaction rate measured by the continuous flow system also showed the same tendency with the batchwise system's data. (auth)

18728 (NIJS-R-458) GASES EVOLVED BY ^{60}Co RADIATION DEGRADATION OF STRONGLY ACIDIC ION EXCHANGE RESINS. Mohorcic, G.; Kramer, V. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Aug. 1965. 12p. Dep. mn.

The irradiation damage and stability of polystyrene–divinylbenzene and phenol–formaldehyde sulfonic acid ion exchange resins was investigated by determination of the radiolytic gases. A 440 Cu ^{60}Co radiation source was used. Commercial resins, Dowex 50W X10 and Zeo–Karb 215, were prepared under strict conditions in free acid and in salt forms, in an excess of deaerated water, swollen with a known amount of water, and in a very dry state. A series of 6 equal samples were exposed to integral doses of 50 to 200 Mrads at a dose rate 2.5×10^5 rads/hr. The gas analysis shows a very good linear dose dependence of the evolved hydrogen and carbon monoxide. The linearity of carbon dioxide was good for Dowex 50W X10 but less pronounced for Zeo–Karb 215. Sulfur dioxide was at least partially produced by direct action and consumed by secondary reactions during irradiation. Under chosen experimental conditions the evolved hydrogen amounts for the absorbed dose 1 Mrad ranged from 0.3 to 670 μmoles H_2/eq. resin. The values for carbon dioxide and carbon monoxide are: 1.4–170 μmoles CO_2/eq. and 0.4–5.3 μmoles CO/eq. The corresponding G values are: 0.001–1.7 for hydrogen, 0.007–0.43 for carbon dioxide and 0.002–0.027 for carbon monoxide. The G values for sulfur dioxide, calculated from the lowest absorbed doses, are between 0.001 and 0.87. (auth)

18729 (NYO-2007-9) RADIATION CHEMISTRY. Final Report, April 1, 1965–August 31, 1965. Mains, Gilbert J. (Carnegie Inst. of Tech., Pittsburgh, Pa.). Feb. 20, 1966. Contract AT(30-1)-2007. 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Mercury sensitized photolysis techniques were applied to the synthesis of volatile hydride derivatives of carbon, silicon, and germanium. Methylsilane, germylsilane, and germyl methyl ether were prepared by the mercury photosensitized decomposition of methyl iodide-silane, germane-silane, and methanol-germane mixtures respectively. Some physical properties of the new compound germyl methyl ether are described. The radiolysis of tetramethylsilane (TMS) in the liquid phase was investigated in order to provide information relative to the effect of phase on primary product yields and reaction mechanisms. The results showed significant differences in product distribution as compared with the gas phase data. The liquid phase products are tentatively explained by a free radical mechanism, while the difference in product distribution observed for the two phases irradiated was interpreted in terms of cage effects in the liquid. Data obtained from scavenger studies, and information provided by isotopic distributions observed in the products from irradiation of an equimolar mixture of TMS and TMS-d_{12} suggest that the contribution of molecular elimination reactors to the products of liquid phase radiolysis cannot be ignored. A mercury photosensitization study was undertaken to determine the relative efficiencies of SiH_4 and C_2H_4 as H atom scavengers. The atoms are generated from deuterium so that the reaction competition can be investigated by examining the distribution of deuterated products. Very preliminary studies indicate that the reaction scheme is somewhat more complicated than anticipated, and that it may be necessary to synthesize some partially deuterated hydrocarbons for use as standards in order to accurately estimate the reaction products. (auth)

18730 (UJV-1468) A STUDY OF RADIOLYSIS OF ORGANIC BINARY MIXTURES FROM THE POINT OF VIEW OF RADIATION SYNTHESIS. Chutny, B.; Kourim, P.; Kucera, J.; Urban, J.; Vagner, J.; Vocilka, J. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1966. 23p. Dep. mn.

The radiolysis of binary mixtures of olefinic compounds with carbon tetrachloride or isopropyl alcohol was studied. From the variation of yields of reaction products with the initial composition of the mixtures the way in which they are formed was established and optimum conditions leading to the addition products were found. (auth)

18731 PRODUCTION OF STABLE KRYPTON AND XENON ISOTOPES BY IRRADIATION OF ALUMINUM HALIDES IN REACTORS. Murin, A. N.; Levskii, L. K.; Zakharova, A. E. At. Energ. (USSR), 19: 458-9(Nov. 1965). (In Russian).

Enriched isotopes of the inert gases may be obtained by exposure of aluminum halides to a neutron flux. The halides were prepared by the reduction of the corresponding Ag halide with Al in quartz containers at about 400°C. Irradiation of 20 g of the Al halides by a total flux of 2.16×10^{17} n/cm^2 resulted in the following yields of gaseous products: from $AlBr_3$, 2.4×10^{-2} cm^3 of ^{80}Kr and 0.6×10^{-2} cm^3 of ^{82}Kr(using ^{79}Br and ^{81}Br, respectively); from $Al^{127}I$, 6.8×10^{-4} cm^3 of ^{128}Xe. After exposure to high temperatures for three weeks, the quartz ampoules placed in a gas purification system containing liquid nitrogen or dry ice (for work with xenon) traps, KOH, CuO, and Ca. The purified gases were transferred into ampoules containing active carbon. Mass spectrograms of xenon exhibited only the peak corresponding to ^{128}Xe; the atmospheric impurities amounted to less than 0.1%; those of krypton showed that the mixture contained $^{80}Kr/^{82}Kr$, at a ratio of 3.8, as expected from calculations. Atmospheric impurities were present in amounts less than 0.05%. (TTT)

18732 SIMPLE ^{60}Co-HECTOCURIE UNIT FOR RADIOCHEMICAL EXPERIMENTS. Luethy, H.; Mohler, H. (Univ., Basel). Atompraxis, 12: 104-7(Feb. 1966). (In German).

Using a ^{60}Co source from a medical irradiation instrument (activity in 1965: 115 C), a pilot irradiation unit was constructed in which the source can be removed from its protective lead container and placed in exposure position by means of a vertical cable. A simple mechanical-electromagnetic door-lock device for the irradiation area makes it possible to carry out prolonged irradiation even during current failure. The dose output in the immediate vicinity of the source is extrapolated from ionometric measurements. For irradiating thin cellulose layers at a minimal distance, dose rates calculated with regard to Compton-electron scattering are listed. (auth)

18733 THE RANGES OF INTERACTIONS IN THE RADIOLYSIS OF SOLID HYDROCARBON MIXTURES. Dyne, P. J.; Denhartog, J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 44: 461-75 (Feb. 15, 1966). (AECL-2260).

A novel technique for measuring the ranges of interaction in the radiolysis of hydrocarbon mixtures, e.g., the distance between donor and acceptor molecules in an energy transfer process is described. Thin layers, 20 to 1000Å thick, of solid c-C_6D_{12} sandwiched between other materials, which activate or deactivate the hydrocarbon, were irradiated. The yields of D_2 and HD were measured as a function of the layer thickness. These yields changed rapidly when the layer thickness was comparable with the range of the interaction. The activation of c-C_6D_{12} by n-C_6H_{14} had a very short range consistent with an ion-molecule reaction between nearest neighbor molecules. The deactivation by CCl_4 or benzene had a longer range (180 Å or more) consistent with the average separation of positive ions and electrons in an irradiated hydrocarbon. The intermediates in the bimolecular reaction giving HD in layers of C_6D_{12} and C_6H_{12} had a short range (<100 Å) and could not be thermal hydrogen atoms. (auth)

18734 PARAMAGNETIC CENTERS IN IRRADIATED POTASSIUM SULFATE. Gromov, V. V.; Morton, J. R. Can. J. Chem., 44: 527-8(Feb. 15, 1966). (NRC-8807).

ESR spectra of irradiated potassium sulfate single crystal were studied at 77 to 300°K. Different stages in radiation damage were revealed. The spectra at 77°K demonstrated the presence of a single paramagnetic species, A, characterized by a highly anisotropic g-tensor. On warming over 90% of A decomposed to form a second species, B, although the amount of A surviving at 300°K was sufficient to permit determination of its g-tensor at 300°K. The radical B was characterized by an almost isotopic g-tensor. It was concluded that A and B were SO_4^- and SO_3^-, respectively. (F.J.H.)

18735 SENSITIZED RADIOLYTIC ISOMERIZATION OF STILBENE. Lehmann, H. P. (Weizmann Inst. of Science, Rehovoth Israel); Stein, G.; Fischer, E. Chem. Commun., No. 22, 583-5(Nov. 24, 1965).

Energy transfer reactions in the x and gamma radiolysis of stilbene in dilute ($<10^{-4}$ molar) benzene solutions were studied. The presence of oxygen or anthracene sharply reduced the rate of radiolytic isomerization in very dilute solutions, the effect becoming smaller with increasing stilbene concentration. However, naphthalene, phenanthrene, and triphenylene all enhanced the isomerization rates in both directions. G-values in the presence of the enhancing compounds increased with the latters' concentration and approached limiting values. The results are explained by assuming that absorption of radiation by stilbene leads to the formation of an active species able to react with stilbene to bring about isomerization. Added solutes will compete with stilbene for active benzene molecules. (P.C.H.)

18736 LOCALIZATION OF ENERGY IN RADIOLYSIS OF SOLUTIONS. IV. HYDROGEN YIELDS IN BINARY MIXTURES OF METHANOL, WATER, AND PYRIDINE. Schweiner, Z.; Janovsky, I.; Bednar, J. (Inst. of Nuclear Research, Rez, Czechoslovakia). Collect. Czech. Chem. Commun., 31: 43-50(Jan. 1966).

Results from radiolysis of mixtures of water and pyridine indicated that so-called "molecular" hydrogen is formed in water by two mechanisms. In analogous mixtures of methanol with pyridine it was possible to separate the hydrogen yield of G = 0.9 to 1.1, which was ascribed to diffusing electrons originating from methanol. The effect of pyridine on the total yield of hydrogen from methanol was the same as that of benzene, which can be due to their similar spectral properties. The hydrogen yield from mixtures of water and methanol indicated the preferential localization of absorbed energy on methanol molecules. (auth)

18737 INFLUENCE OF TRACES OF WATER ON THE RADIOLYSIS OF LIQUID ACETONE. Kucera, J. (Inst. of Nuclear Research, Rez, Czechoslovakia). Collect. Czech. Chem. Commun., 31: 355-8(Jan. 1966).

The hypothesis that the differences in yields of gaseous products from the radiolysis of acetone dried in different ways are a consequence of different water contents in irradiated acetone was checked. Samples were irradiated at 15 to 20°C using a ^{60}Co gamma source. Yields of acetic acid, acetaldehyde, and acetonylacetone were higher in the presence of water, while that of diacetyl was less. Reactions are postulated to explain the yields. (M.C.G.)

18738 REINFORCING EFFECT OF INFRARED RADIATION ON THE LUMINESCENCE OF (Zn,Cd)S : Mn EXCITED BY α RADIATION; STUDY OF THE INDIVIDUAL SCINTILLATIONS. Geoffroy, Andre (Faculte des Sciences, Paris). Compt. Rend., 261: 5072-5(Dec. 8, 1965). (In French).

The reinforcing effect of infrared radiation on the total light emission and on the individual scintillations in (Zn,Cd)S : Mn excited by ^{210}Po α rays was studied. (tr-auth)

18739 ELECTRON PARAMAGNETIC RESONANCE OF IRRADIATED STRONTIUM NITRATE. Petit, Pierre (Faculte des Sciences, Orsay, France). Compt. Rend., 261: 5076-9(Dec. 8, 1965). (In French).

The three centers created in strontium nitrate by irradiation with 1.5-Mev electrons were studied by electron paramagnetic resonance. These centers were attributed to the radicals NO_3, NO_3^{2-}, and NO_2. (tr-auth)

18740 EVIDENCE OF PARAMAGNETIC PAIRS OF ALUMINUM IONS IN REACTOR-IRRADIATED ALUMINA. Cox, Ronald; Herve, Alain (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., 261: 5080-3(Dec. 8, 1965). (In French).

The electron paramagnetic resonance spectra of α-Al_2O_3 irradiated at 77 and 30°C in the reactor at Grenoble showed two faults: a pair of Al ions in which the axis is parallel to the trigonal crystalline axis c and a similar pair in which the axis is inclined 9° on c. The most probable model for the parallel pair is an interstitial + cation pair. The nonparallel pair seemed to be the same pair of Al ions but disturbed in another placed beyond the axis with proximity. (J.S.R.)

18741 STUDY BY CHROMATOGRAPHY IN THE GASEOUS PHASE OF THE LIGHT PRODUCTS OF THE RADIOLYSIS OF POLYOXYETHYLENE GLYCOL IN AQUEOUS SOLUTION. Decker, Christian; Vacherot, Monique; Marchal, Jean (Centre de Recherches sur les Macromolecules, Strasbourg). Compt. Rend., 261: 5104-7(Dec. 8, 1965). (In French).

The chromatography in the gaseous phase of light products of the oxidizing radiolysis of polyoxyethylene glycol in aqueous solution showed that the two formic esters of the glycol are important reaction products. The effects of the polymer concentration and the solution pH were studied. (tr-auth)

18742 PROTON TRANSFER REACTIONS OCCURRING IN GAS-PHASE RADIOLYSIS. Ausloos, P.; Lias, S. G. (National Bureau of Standards, Washington, D. C.). Discuss. Faraday Soc., No. 39, 36-44(1965).

From the products formed in the gas-phase radiolysis of various reaction mixtures containing deuterium labeled compounds, it is inferred that: H_3^+, ArH^+, KrH^+, and probably XeH^+ transfer a proton to n-pentane. In all cases, the protonated pentane ion decomposes to methane, ethane, propane, and the corresponding butyl, propyl, and ethyl ions. The relative probability of these three fragmentation processes does not vary with the nature of the proton donor, within experimental error. H_3^+, ArH^+, KrH^+ and CH_5^+ effectively transfer a proton to cyclopropane. On the basis of isotopic labeling experiments, it is deduced that the protonated cyclopropane rearranges to the sec-propyl ion structure prior to or during reaction. Similarly, the protonated cyclobutane rearranges to the sec-butyl ion structure. H_3^+, ArH^+ and KrH^+ transfer their proton to ethylene, propylene, and butene, to form mainly ethyl, sec-propyl, sec-butyl ions, respectively. Carbonium ions such as $C_2H_5^+$ can also transfer a proton to olefins. In the latter case, however, alternative modes of reaction such as addition and hydride transfer reactions occur as well. (auth)

18743 INVESTIGATION INTO THE PHYSICAL AND CHEMICAL PROPERTIES OF THE PRODUCT FORMED BY THE RADIOLYSIS OF CRYSTALLINE o-NITROANILINE. Zedelashvili, E. N. (Melikishvili Inst. of Physics and Organic Chemistry, Academy of Sciences, Georgian SSR). Dokl. Akad. Nauk SSSR, 164: 334-5(Sept. 11, 1965). (In Russian).

Gamma irradiation of crystalline o-nitroaniline was accompanied by deepening of the color, which became dark brown at a total dose of 10^{23} ev. Studies on the brown solid obtained indicated that it was an organic semiconductor. It was separated by washing the solid irradiation product with several organic solvents, in which it was insoluble. Chemical microanalysis showed it to be 3.53% H, 62.59% C, 17.91% N, 15.97% O (by difference). A Debye diagram showed it to have a crystalline structure. It did not melt when heated to 800°C in an inert atmosphere, and its electric conductivity was 10^{-3} ohm^{-1} cm^{-1}. Infrared absorption spectrum studies of an emulsion of the brown substance in a fluorocarbon showed a wide band at 3000–3500 cm^{-1} with a center around 3325 cm^{-1} and maximums at 3061, 3200, and 3155 cm^{-1}. Mass spectrographic studies showed a molecular weight of 474 ± 2, but the insolubility in organic solvents, deep color, high thermal stability, and rather high electric conductance indicated a higher molecular

weight. The electric conductivity was a linear function of the temperature, and the curve was in two parts, indicating the presence of a mixture. The activation energies determined from the slopes of the two parts of the curve were 0.29 and 0.8 ev, respectively. The evidence indicated a large number of de-localized π electrons. Irradiation may cause some condensation of molecules. (TTT)

18744 RADIATION-CATALYTIC CONVERSION OF METHANOL. Vladimirova, V. I.; Zhabrova, G. M.; Kadenatsi, B. M.; Kazanskii, V. B.; Pariiskii, G. B. (Inst. of Chemical Physics, Academy of Sciences, SSSR). Dokl. Akad. Nauk SSSR, 164: 361-4(Sept. 11, 1965). (In Russian).

It was previously found that during the combined action of ionizing radiation and solids of different electronic properties, the dielectric-type oxides, SiO_2, Al_2O_3, and aluminum silicate $SiO_2 \cdot Al_2O_3$, in which paramagnetic centers and adsorbed radicals were detected, displayed the greatest activity in the conversion of cyclohexane in the adsorbed layer, whereas semiconductors and metals, which had no paramagnetic centers or radicals, were inactive. In order to determine the scope of these findings, a similar study was made on the radiation-catalytic decomposition of methanol in the adsorbed layer at 20°C, ^{60}Co gamma radiation was used (dose rate, 4.3×10^{16} ev/g · sec; adsorbed radiation dose, 8.2×10^{19} to 7×10^{21} ev/g). It was found that as in the case of the heterogeneous radiolysis of cyclohexane, SiO_2, Al_2O_3, and $SiO_2 \cdot Al_2O_3$ were the most effective catalysts for methanol; the radiation-chemical yield and rate of formation of hydrogen, formaldehyde, and ethylene glycol on silica gel were ten times as high as in the case of homogeneous radiolysis. The electron spin resonance spectra of the radicals formed on SiO_2 and Al_2O_3 were recorded. Oxides with semiconducting properties such as ZnO showed a considerably lesser catalytic activity. The results confirmed the relation established earlier between the radiation-catalytic activity of solids and their electronic properties. The high radiation-chemical yields of hydrogen, formaldehyde, and ethylene glycol during decomposition of methanol on silica gel, aluminum oxide, and aluminum silicate are apparently closely related to the processes of transfer of the energy of ionizing radiation absorbed by these solids to the molecules adsorbed on the surface. (CFSTI)

18745 YIELD OF PRODUCTS OF WATER RADIOLYSIS IN ACID SOLUTIONS SATURATED WITH ARGON UNDER HIGH PRESSURE. Shubin, V. N.; Dolin, P. I. (Inst. of Electrochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 164: 382-3(Sept. 11, 1965). (In Russian).

To clarify the role of structure and its breakdown in liquid water during radiolysis, ferrous solutions in 0.8 N sulfuric acid were irradiated in the presence of oxygen, $Ce(SO_4)_2$, and mixtures of hydrogen plus oxygen, the solutions being saturated with argon under pressures of up to 2800 atm. No change in the oxidation yield occurred with increasing pressure from 1 to 100 atm, but from 100 to 1500 atm the oxidation yield increased rapidly. From 1500 to 2000 atm there was no further increase. In the last phase, $G(Fe^{3+})_{O_2} = 29$ ions/100 ev, $G(Ce^{3+})_{O_2} = 10.0$ ions/100 ev, and $G(H_2O_2)_{H_2+O_2} = 9.6$ molecules/100 ev, which are higher values than found under ordinary conditions. From the data the values $G_H = 4.9$, $G_{OH} = 4.6$, $G_{H_2} = 4.7$, and $G_{H_2O_2} = 4.85$ were calculated, and the total yield of water decomposition products was 14.3/100 ev. This value is too large to be explained only by ionization processes. If the sharp increase in yield of molecular products is the result of the activation state being reached, doubt is raised concerning the significant role of track formation in cases of mild irradiation. (TTT)

18746 GAMMA-RAY RADIOSYNTHESIS OF OZONE FROM AIR. Shah, J.; Maxie, E. C. (Pakistan Atomic Energy Commission, Karachi. Univ. of California, Davis). Contract UCD-34P73. Int. J. Appl. Radiat. Isotop., 17: 155-9(Mar. 1966).

Ozone concentrations were measured in static and flowing systems of air during γ irradiation in the Mark II Research Irradiator. In a flowing system, the concentration of ozone varied from 1.68 to 1.74 ppm over a dose range of 50 to 1000 krad; the G values were about 11. In a static system the concentration varied from 7.36 to 58.09 ppm, depending on the dose. The highest G value (6.2) was obtained at 50 krad, the lowest (2.04) at 1000 krad. (auth)

18747 THE EFFECT OF PENETRATING RADIATION ON THE PROPERTIES OF POLYAMIDE FIBERS. PART II. EXPERIMENTAL RESULTS. Heger, A. (Institut fuer Technologie der Fasern, Dresden). Isotopenpraxis, 1: 110-22(Dec. 1965). (In German).

The effects of penetrating radiation on various properties of fibrous polyamide 6 (Dederon monofil) are discussed. An attempt was made to interpret or characterize the radioinduced effects in polamide 6. (auth)

18748 TRAPPED HYDROGEN ATOM YIELDS AND PRECURSORS IN FROZEN SOLUTION RADIOLYSIS. Kevan, Larry; Fine, Carol (Univ. of Chicago. Univ. of Kansas, Lawrence). J. Amer. Chem. Soc., 88: 869-72 (Mar. 5, 1966).

Trapped hydrogen atom yields from the radiolysis of γ-irradiated frozen solutions at 77°K were measured for over 35 oxyanion salts; 15 of these were found to trap hydrogen atoms. Hydrogen atoms were trapped only by oxyanions in their highest oxidation states except for selenite. Hydrogen atom yields were decreased by added electron scavengers such as nitrate ion in ices containing mononegative and large dinegative oxyanions. The relative rates of decrease by nitrate and nitrite scavengers indicated that the mobile precursor of the trapped hydrogen atoms is an electron rather than a hydrogen atom. Optical bleaching on irradiated ices containing $H_2PO_4^-$ and ClO_4^- produced additional trapped hydrogen atoms. The bleaching effect was thought to be due to dissociation of trapped radical anions formed by reaction of a mobile electron. Scavenging and bleaching experiments indicated that positive holes also react with the oxyanion to form trapped, bleachable centers. (auth)

18749 FREE-RADICAL DISTRIBUTION IN THE γ-RADIOLYSIS OF DRY RIBONUCLEASE. Riesz, Peter; White, Frederick H. Jr.; Kon, Hideo (National Insts. of Health, Bethesda, Md.). J. Amer. Chem. Soc., 88: 872-7(Mar. 5, 1966).

A method for determining the distribution of free radicals on carbon in irradiated dry proteins was developed. Gamma radiolysis of ribonuclease in the absence of air and subsequent exposure to tritiated hydrogen sulfide led to the formation of carbon–tritium bonds. The amount of such tritium incorporated per amino acid residue was much greater for certain amino acids (lysine > methionine > proline > histidine) than for others (phenylalanine > isoleucine > valine); the maximum difference exceeded a factor of 70. Contrary to past interpretations of EPR spectra, glycine radicals did not play a dominant role under these conditions. Analogous experiments with carboxymethylated reduced ribonuclease suggested that free-radical distribution depends markedly on molecular conformation of the protein. (auth)

18750 CONFORMATIONS OF THE FREE RADICAL IN IRRADIATED α-AMINOISOBUTYRIC ACID. Box, Harold C.; Freund, Harold G. (Roswell Park Memorial Inst., Buffalo). J. Chem. Phys., 44: 2345-8(Mar. 15, 1966). (NYO-3558-1).

The electron paramagnetic resonance spectrum of x irradiated α-aminoisobutyric acid was studied in single crystals irradiated at 77°K and allowed to warm up gradually. Different conformations of the free-radical $(CH_3)_2CCOOH$ were observed. The g tensor and the hyperfine splitting tensor were determined for each conformation. (auth)

18751 MOLECULAR IONS IN RADIATION CHEMISTRY. I. FORMATION OF AROMATIC-AMINE CATIONS IN CCl_4 BY RESONANCE CHARGE TRANSFER AT 77 DEG K. Shida, Tadamasa; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 44: 2369-74(Mar. 15, 1966).

Gamma irradiated polycrystalline CCl_4 at 77°K provided

evidence that positive charge migrates and is trapped by the matrix itself. The trapped positive hole absorbs at about λ_{max} = 400 mμ in pure CCl_4 or dilute solid solutions of aromatic amines. The solvent band is depressed by aromatic amines or other additives which act as hole traps with appearance of the corresponding amine cation absorption. After γ irradiation the residual 400-mμ band photobleached at 77°K with increase in solute cation absorption. Brief heating to 143°K gave the same result. A kinetic treatment which assumes that the only labile species in the system is migrating positive charge can explain the experimental results in a satisfactory way. The kinetic analysis gave a rough estimate of total available positive charge created per 100 ev of absorbed energy as 1.9. Several aromatic amines were used as test substances and their optical absorption spectra recorded. (auth)

18752 MOLECULAR IONS IN RADIATION CHEMISTRY. II. AROMATIC-HYDROCARBON CATIONS IN CCl_4 AT 77 DEG K. **Shida, Tadamasa; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 44: 2375-7(Mar. 15, 1966).**

Solutions of aromatic hydrocarbons in a polycrystalline matrix of CCl_4 at 77°K were γ irradiated and well-resolved optical absorption spectra measured in the interval 270–2000 mμ. All spectra characteristic of solute were attributed to molecular monopositive ions of benzene, toluene, bi- and triphenyl methanes, biphenyl, o-, m-, and p-terphenyl, bi-, tri-, and tetraphenylethylene, biphenylacetylene, naphthalene, anthracene, phenanthrene, stilbene, diphenylstibene, and 1,3,5-triphenylbenzene. Resonance charge transfer from CCl_4^+ to CCl_4, terminated by transfer from CCl_4^+ to solute, is postulated. (auth)

18753 IONIC PROCESSES IN γ-IRRADIATED ORGANIC SOLIDS: POSITIVE-HOLE MIGRATION IN 3-METHYLPENTANE. **Gallivan, James B.; Hamill, William H. (Univ. of Notre Dame, Ind.). J. Chem. Phys., 44: 2378-88(Mar. 15, 1966).**

The yields of positive and negative species trapped in γ irradiated organic glasses at –196° were measured as a function of glass composition. Increased yields of solvent-trapped electrons (e^-) and biphenyl anions (ϕ_2^-), as well as decreased yields of various solute cations (A^+), were noted when additives capable of undergoing charge-transfer or proton-transfer reactions were present in small amounts (<2 mole %) in 3-methylpentane (3MP). All results can be understood qualitatively in terms of the mobile positive hole being transferred from 3MP to these additives and trapped. A simple scheme of competition for the total available number of positive holes accounts for the decrease in A^+ when a second solute (B) is added and relative cross sections to form A^+ and B^+ can be determined. Additives affect the optical absorption spectrum of (e^-) in 3MP. The spectra of the biphenyl positive and negative ions are similar but displaced, while the anion and cation from benzene are anomalous in 3MP glass. The rates of decay of N, N, N′, N′-tetramethylphenylenediamine cation and of (e^-) were compared following γ irradiation and photoionization of the amine in 3MP. Very efficient attachment of photoelectrons by ϕ_2 indicated an average track volume $>10^{-18}$ cc. (auth)

18754 ENERGY-PARTITION PARAMETERS IN RADIATION STUDIES OF MOLECULAR GASES. **Klots, Cornelius E. (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 44: 2715-18(Apr. 1, 1966). (ORNL-P-1749).**

Ion-yield measurements in binary mixtures of 18 molecular gases are reported. They may be analyzed so as to yield a series of apparent molecular parameters, most generally interpreted as weighting coefficients for calculating dose partition in radiation chemistry studies of mixtures. The existence of a Jesse effect in an occasional molecular gas mixture is noted. (auth)

18755 ELECTRON SPIN RESONANCE OF A GAMMA-IRRADIATED SINGLE CRYSTAL OF BARBITURIC ACID DIHYDRATE. **Bernhard, William; Snipes, Wallace (Pennsylvania State Univ., University Park). Contract NsG-324. J. Chem. Phys., 44: 2817-20(Apr. 1, 1966).**

Free radicals produced in single crystals of barbituric acid dihydrate by ionizing radiation were identified by ESR spectroscopy and the parameters of the Hamiltonian describing the free radicals were determined. The stable radical observed at room temperature was formed by loss of a hydrogen atom from $C_{(5)}$ of the original molecule, thus leaving an unpaired electron mainly in a 2pπ orbital on the carbon atom. Within experimental error, the free radicals have the same orientation in the crystal lattice as did the original molecules. Principal values of the g tensor characterizing the resonance were found to be $g_u = 2.0044$, $g_v = 2.0056$, and $g_w = 2.0022$. Hyperfine interaction of the unpaired electron with the single hydrogen atom bonded to $C_{(5)}$ of the free radical splits the absorption into a doublet. Principal values of the hyperfine tensor were found to be $A_x = 11.2$ G, $A_y = 30.0$ G, and $A_z = 20.4$ G. The principal axis systems for the g tensor and the hyperfine coupling tensor coincide. Two sets of satellite lines corresponding to changes in the spin states of one and two neighboring protons concurrent with the change in spin state of the unpaired electron were observed. (auth)

18756 ULTRAVIOLET ABSORPTION SPECTRUM OF THE ALLYL FREE RADICAL IN IRRADIATED POLYETHYLENE. **Bodily, D. M.; Dole, M. (Northwestern Univ., Evanston, Ill.). J. Chem. Phys., 44: 2821-2(Apr. 1, 1966).**

The uv absorption spectrum of the allyl free radical was observed in gamma-irradiated solid polyethylene at liquid-nitrogen temperature. The spectrum has a strong peak at 258 mμ, which was identified as the calculated strong absorption band of Longuêt-Higgins and Pople. It was postulated that, because of the disubstituted nature of the allyl free radical, the maximum of the absorption band underwent a bathochromic shift to a higher wavelength. The band at 258 mμ decayed on standing at room temperature in a vacuum and disappeared on admission of oxygen or nitric oxide to the irradiation cell. (M.C.G.)

18757 ELECTRON SPIN RESONANCE OF IRRADIATED SINGLE CRYSTALS OF SUCCINAMIDE. **Kashiwagi, Michio (Toyo Rayon Co., Ltd., Kamakura, Japan). J. Chem. Phys., 44: 2823-4(Apr. 1, 1966).**

Electron spin resonance analyses of irradiated single crystals of succinamide and of the hyperfine couplings for N and H nuclei in $\geq\dot{C}-CONH_2$ are reported. The crystals were x-irradiated at room temperature to 1 Mrad. ESR spectra are shown for succinamide and succinamide-d_4. The spectrum of the irradiated succinamide-d_4 was a doublet-triplet-triplet. The spectrum of the irradiated succinamide was such that each line of the spectrum of the deuterium-labeled compound was further split into a triplet. This indicated that radicals produced in succinamide are of the form $NH_2CO-C_\beta H_{\beta_1}H_{\beta_2}-\dot{C}_\alpha H_\alpha-CONH_{\gamma_1}H_{\gamma_2}$. (M.C.G.)

18758 ELECTRON PARAMAGNETIC RESONANCE AND PHASE TRANSITIONS IN SOLID CYCLOHEXANOL. **Szwarc, Henri. J. Chim. Phys., 63: 137-41(Jan. 1966). (In French).**

An ESR study of free radicals produced at 77°K in γ-irradiated cyclohexanol showed that the radical recombination depended on heat treatments previously undergone by the samples. The recombination was found to take place at phase transition temperatures and this led to the assumption that two metastable phases may exist in solid cyclohexanol at low temperature. (auth)

18759 THERMOLUMINESCENCE OF IRRADIATED MOLECULAR SOLIDS AND PHASE CHANGES. **Magat, Michel (Faculte des Sciences, Orsay, France). J. Chim. Phys., 63: 142-9(Jan. 1966). (In French).**

Present ideas about the slowing down and trapping of subexcitation electrons in polar and nonpolar media, in the presence and absence of molecules or radicals with electron affinity, are summarized. Some considerations are given concerning the mode of formation and the nature of positive ions. The different types of information that can be obtained by study of the thermoluminescence due to charge recombination are indicated. It is shown that the temperature of thermoluminescence peaks coincides

with the appearance of molecular movements in the crystal, as suggested by Semenoff, Bouben, and Nikol'sky. In some cases investigated, coincidence was proved for all thermoluminescence peaks. Determination of activation energies gave additional support to corroborate these conclusions. It was concluded that the study of thermoluminescence peaks constitutes a sensitive tool for the detection of movements in molecular crystals. Since thermoluminescence is sensitive to the presence of physical and chemical defects in crystals it can be used for their detection. (auth)

18760 ROLE OF MOLECULAR MOTIONS IN THERMOLUMINESCENCE OF ORGANIC SOLIDS IRRADIATED AT 77 DEG K. Bullot, Jacques; Deroulede, Alain; Kieffer, Fernand (Faculte des Sciences, Orsay, France). J. Chim. Phys., 63: 150-6(Jan. 1966). (In French).

The influence of annealing on the position of peaks in the glow curves of cyclohexane and ethanol and on the total light output was studied. Glow curves for glassy and crystalline ethanol were compared. The nature of electron traps and their relation to annealing are discussed. The role of impurities acting as traps was studied with biphenyl added to these solvents. The thermoluminescence spectrum of these solutions was identified with the phosphorescence spectrum of biphenyl. (auth)

18761 THERMAL ANNEALING OF PARAMAGNETIC DEFECTS INDUCED BY GAMMA IRRADIATION IN $(NH_4)_2SO_4$ AND $(ND_4)_2SO_4$ SINGLE CRYSTALS. I. EXPERIMENTAL VERIFICATION OF THE THEORY OF FLETCHER AND BROWN. Calusaru, A.; Barbur, I.; Ursu, I. (Univ., Cluj). J. Chim. Phys., 63: 249-56(Feb. 1966). (In French).

In irradiated crystals of $(NH_4)_2SO_4$ and $(ND_4)_2SO_4$ two paramagnetic species were identified using electron spin resonance. The constant g for the first radical in $(NH_4)_2SO_4$ is 2.014 and for the second 2.020; the corresponding constants for a crystal containing heavy hydrogen are 1.9996 and 2.0032. Studies of thermal annealing of the first radical in the interval from 60 to 170°C showed a time variation with the same plateau. It was possible to establish the corresponding equation using the error function derived by Fletcher and Brown taking into consideration the model of recombination of correlated pairs after a random-walk process. When using the phenomenologic description of Fletcher and Brown the following values of activation energy were obtained: 1.594 ev for the first radical of $(NH_4)_2SO_4$ and 1.663 ev for that of $(ND_4)_2SO_4$. By means of the method of the variation of the diffusion coefficient with temperature the value of activation energy was calculated and was found to be in good agreement with the value obtained by an alternative method. A discussion of experimental results is given. (auth)

18762 EFFECTS OF ELECTRON BEAM IRRADIATION ON POLYVINYL CHLORIDE. Yeh, Si-Jung; Chen, Tsan-Jan (Naticnal Tsing Hua Univ., Taiwan). J. Chin. Chem. Soc. (Taiwan), Ser. II, 12: 116-26(Sept. 30, 1965).

Thin films of fractionated polyvinyl chloride were irradiated both in the air and in vacuum with electron beams generated by a Van de Graaff generator. The dose rates used ranged from 3.97×10^3 to 3.47×10^4 rads/sec. The temperature of irradiation was kept below 30°C to eliminate the heat effect due to electron-beam irradiation. The molecular weights of the irradiated polymer were estimated by measuring the viscosity of irradiated polyvinyl chloride solution in cyclohexanone. The estimation was carried out immediately after irradiation to avoid post-irradiation effects. When the polyvinyl chloride was irradiated in the air with dose rates below 2.27×10^4 rads/sec, the molecular weights of irradiated polyvinyl chloride decreased gradually. Beyond the total dose of 3.4×10^6 rads, however, the molecular weights of irradiated polyvinyl chloride began to increase. When a dose rate higher than 2.87×10^4 rads/sec was applied, the molecular weights of the irradiated polyvinyl chloride increased as soon as the polymer was subjected to irradiation. In all cases studied the molecular weights of polyvinyl chloride increased rapidly beyond the total dosage of 5×10^6 rads, and the polymer became insoluble when the total dosage reached 7×10^6 rads. (auth)

18763 PROCESSES ASSOCIATED WITH THE $^6Li(n,\alpha)^3H$ NUCLEAR REACTION. I. RELEASE OF TRITIUM FROM LITHIUM CHLORIDE. Mantescu, Constanta; Costea, T. (Inst. of Atomic Physics, Bucharest). J. Inorg. Nucl. Chem., 28: 273-84(Feb. 1966).

An attempt was made to establish the kinetics of the thermal release process for volatile tritium compounds and to discuss both the chemical and physical implications of the behavior of the recoil tritium in reactor irradiated lithium chloride. The kinetics of the thermal release was interpreted in terms of processes distributed in the activation energy. In order to explain the formation of TCl and LiT a model based on crystalline defects resulting from the irradiation was proposed. (auth)

18764 VARIOUS PARAMETERS AFFECTING RETENTION AND SPECIFIC ACTIVITY IN S.-C. REACTION OF HEXAMMINE- AND TRISETHYLENEDIAMINE-COBALT IONS ON AN ION-EXCHANGER. Matsuura, T. (Rikkyo Univ., Yokosuka, Japan). J. Inorg. Nucl. Chem., 28: 313-21(Feb. 1966).

$Co(NH_3)_6^{3+}$ and $Co(en)_3^{3+}$ ions adsorbed on Dowex 50 were irradiated batchwise in a reactor and the recoiling Co^{2+} ion was separated from the resin by elution with 0.5% ammonium citrate solution (pH 5.0). The retention decreased with lower stability of the complex ion, admixture of the H^+ form of the resin, shorter storage time (except for the H^+ form mixture), higher cadmium ratio and lower gamma dose rate at the irradiation position, shorter irradiation time, and lower reactor power output. The specific activity increased with higher stability of the complex ion, mixing with the H^+ form, and higher cadmium ratio at the irradiation position. (auth)

18765 COMPETITION BETWEEN THERMAL ANNEALING AND DECOMPOSITION. Costea, T.; Negoescu, Irina (Inst. of Atomic Physics, Bucharest). J. Inorg. Nucl. Chem., 28: 323-9(Feb. 1966).

The competition between thermal annealing and decomposition, illustrated by the cobalt recoil atom behavior in $CoEn_3(NO_3)_3$, $(Co(NH_3)_6(CrO_4)_3$, and $Co(NH_3)_6(NO_3)_3$ was studied. The experimental results are discussed in connection with the temperature and concentration and kind of defect influence on the annealing–decomposition competition. (auth)

18766 THE γ-RADIOLYSIS OF LIQUID 2-PROPANOL. EFFECT OF NITROUS OXIDE AND SULFURIC ACID. Sherman, Warren V. (Soreq Nuclear Research Center, Yavne, Israel). J. Phys. Chem., 70: 667-72(Mar. 1966).

Gamma radiolysis at relatively low dose of solutions of nitrous oxide and sulfuric acid in 2-propanol was studied. The yields of gaseous products were determined as a function of solute concentration. The results indicated that nitrous oxide scavenges a precursor of molecular hydrogen, and that this precursor is the solvated electron. In addition, nitrous oxide can scavenge species that do not lead to hydrogen. The results of the radiolysis of solutions containing both nitrous oxide and sulfuric acid are consistent with this species being solvated electrons, which do not escape the radiation spurs. The G-value for solvated electrons, which led to hydrogen was 0.9. It was proposed that nitrous oxide may be used to determine the relative reactivity of solutes toward the solvated electron in 2-propanol, and values for several organic solutes are reported. (auth)

18767 ON THE RADIATION CHEMISTRY OF FREMY'S SALT IN AQUEOUS SOLUTION. Rakintzis, N. Th. (Nuclear Research Center Democritus, Athens); Stein, Gabriel. J. Phys. Chem., 70: 727-30(Mar. 1966).

The inorganic free radical nitrosodisulfonate (Fremy's salt, $NO(SO_3)_2^{2-}$) was irradiated with γ rays in aerated aqueous solutions at pH >9.5. At pH 10 to 11 the solutions were stable in the absence of irradiation. On irradiation the decrease in OD at 242 mμ (ϵ 1660 M^{-1} cm^{-1}) was followed and gave strictly zero-kinetics. In the presence of

alcohols a limit of G = 6.1 was obtained. The correlation with G_{H+e+OH} at the pH employed is discussed. (auth)

18768 THE REACTION OF ISOPROPYLBENZENE ON γ-IRRADIATED SILICA–ALUMINA: THE EFFECT OF ANNEALING AND OF EXPOSURE TO HYDROGEN OR OXYGEN. Hentz, Robert R.; Perkey, Lewis M.; Williams, Robert H. (Socony Mobil Oil Co., Inc., Princeton, N. J.). J. Phys. Chem., 70: 731-4(Mar. 1966).

Annealing experiments performed on γ-irradiated silica–alumina indicated that the long-lived radioinduced excitations, which cause dealkylation of isopropylbenzene, can be thermally deactivated. More than one group of such excitations was found to be present in irradiated silica–alumina. Those excitations that anneal at 77°C (and are completely annealed in less than 24 hr at 115°C) correlated with visible color centers that are thermally bleached. Certain of the excitations, not absorbing in the visible, were not annealed even at 300°C. Exposure of the irradiated solid to hydrogen resulted in bleaching of the visible color centers, irreversible adsorption of hydrogen, and elimination of a portion of the excitations that are effective in dealkylation of isopropylbenzene. Expressed as molecules per gram of solid, the amount of hydrogen adsorbed was slightly greater than the reduction in benzene yield. The reduction in benzene yield was also approximately equal to the number of those excitations that can be completely annealed at the lowest temperatures, 77 and 115°C. Oxygen had no effect on the visible color or the benzene yield. The excitations annealing at 77°C were identified tentatively with the visible color centers, which are believed to be associated with positive holes trapped at substitutional aluminum. The likelihood that visible color centers are distributed uniformly throughout the solid suggested that these excitations may be transferred over distances up to 50 to 100 A. The radioinduced dealkylation activity was found to decrease with age of the unirradiated solid. However, only the precursors of the excitations annealing at 77°C were affected. (auth)

18769 THE PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS OF POTASSIUM FERROCYANIDE. Rabani, J.; Matheson, M. S. (Argonne National Lab., Ill.). J. Phys. Chem., 70: 761-9(Mar. 1966).

The pulse radiolysis of deaerated aqueous ferrocyanide was studied in acid, neutral, and alkaline solutions. The value for k(OH + ferrocyanide) was determined as $(1.07 \pm 0.1) \times 10^{10}$ M^{-1} sec^{-1}. In experiments in which OH + ferrocyanide competed with OH recombination, $2k(OH + OH) = (1.26 \pm 0.16) \times 10^{10}$ M^{-1} sec^{-1} was obtained. It is shown that O^- reacts much more slowly with ferrocyanide than does OH, and, from the pH dependence of the apparent rate constant for OH + ferrocyanide, it was established that $[O^-] = [OH]$ at pH 11.9 ± 0.2 in the equilibrium $OH + OH^- \rightleftharpoons O^- + H_2O$. Because of experimental difficulties, precise rate constants for $O^- + OH$ and $O^- + O^-$ recombination were not measurable, but limits for these k values were estimated. (auth)

18770 RADIATION CHEMISTRY OF ISOTACTIC AND ATACTIC POLYPROPYLENE. III. RADIOLYSIS IN THE PRESENCE OF NITROUS OXIDE. Kondo, Marmoru; Dole, Malcolm (Northwestern Univ., Evanston, Ill.). J. Phys. Chem., 70: 883-9(Mar. 1966).

Using ^{60}Co γ rays, isotactic and atactic polypropylene were irradiated in the presence and absence of about 60 cm pressure of nitrous oxide gas. $G(H_2)$ and $G(CH_4)$ were reduced by the N_2O in the same ratio, which is in line with the recent postulates of Dyne. Cross-linking and chain degradation were enhanced, cross-linking somewhat more than degradation. The N_2O probably acts mainly as an electron scavenger. (auth)

18771 RADICAL YIELDS IN THE RADIOLYSIS OF CYCLOHEXENE WITH DIFFERENT KINDS OF RADIATION. Burns, W. G.; Holroyd, R. A.; Klein, G. W. (Atomic Energy Research Establishment, Harwell, Eng. Mellon Inst., Pittsburgh). J. Phys. Chem., 70: 910-24 (Mar. 1966). (RRL-2310-159).

Dilute solutions (1 to 20 mM) of $^{14}CH_3I$ in cyclohexene were irradiated, and yields of radioactive methyl-3-cyclohexene, methylcyclohexane, methyl-1-cyclohexene, ethane, and methane were determined as functions of $^{14}CH_3I$ concentration, energy input, dose rate, and LET of the radiation. The results were interpreted on the basis that thermal $^{14}CH_3$ radicals are formed and react with the surrounding molecules or radicals. The effect of dose rate indicated that as the dose rate decreased, all radicals reacted in greater proportion with the cyclohexene rather than in interradical reactions. The effects of concentration and of LET at high dose rates were consistent with the concept that methyl radicals are generated by electron capture. At high dose rates of low LET radiation only interradical reactions occurred, and the G values of 3-cyclohexenyl, 1-cyclohexenyl, and cyclohexyl radicals determined from the radioactive product yields agreed with those deduced from the C_{12} product yields from the pure liquid. With increasing LET the apparent radical yields from the activity measurements fell more rapidly than those deduced from the C_{12} product yields. This could be due to the inhomogeneity of track reactions and can be accounted for if the CH_3 radicals, have a larger diffusion constant and a larger initial track radius than the cyclohexenyl and cyclohexyl radicals. Diffusion theory calculations indicated that the ratio of the track radii is ~5. (auth)

18772 RADIOLYSIS OF TETRAFLUOROMETHANE. Fajer, J.; MacKenzie, D. R.; Bloch, F. W. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 70: 935-6 (Mar. 1966). (BNL-9602).

In the radiolysis of tetrafluoromethane the products were identified by a combination of gas chromatography and infrared and mass spectrometry using authentic samples for calibration. The effects of the oxygen content on the yields of C_2F_6 and C_2F_5O from radiolysis of CF_4 are discussed. G-values for both products are given. Attempts to observe the CF_3 radical in liquid or in solid CF_4(77°K) were unsuccessful. The radical could be detected only at 4°K or in the presence of fluorine scavengers. The mechanisms for the reactions for radical formation are given. (F.J.H.)

18773 MECHANISM OF RADIATION-INDUCED REDUCTION OF CYTOCHROME C. Matsuda, Hiyoshi; Masuda, Takahiro; Kondo, Masaharu (Tokyo Metropolitan Univ.). J. Radiat. Res. (Jap.), 6: 45-53(Mar. 1965).

Kinetic investigations for reduction of cytochrome c in aqueous solution induced by cobalt-60 gamma rays were carried out. Initial reduction yield of cytochrome c is about 5 as limiting value. The decrease in initial reduction yield in presence of thallous ion as a radical scavenger with ferricytochrome c provides some evidences that OH radicals can contribute to reduction through some possible intermediate. The effects of concentration ration in ferro-ferricytochrome c and thallous ion-ferricytochrome c systems on initial reduction yield were investigated. The results can be explained on the basis of some reaction scheme based on the contribution of OH radicals to reduction of ferricytochrome c. The following rate constants were determined by kinetic treatment of the results: $k^{1+}_{OH+RH_2Fe} = 5 \times 10^{10} M^{-1}$ sec^{-1}; $k^{2+}_{OH+RH_2Fe} = 4.1 \times 10^{10} M^{-1}$ sec^{-1}. (auth)

18774 RADIATION-INDUCED COPOLYMERIZATION OF VINYL ACETATE WITH SULFUR DIOXIDE. Kuri, Zenichiro; Yoshimura, Takauki; Sakurai, Nobuo; Hirutani, Masaaki (Nagoya Univ., Japan). Kogyo Kagaku Zasshi 68: 1117-21(June 1965). (In Japanese).

Electron spin resonance and ir studies were used to follow the products formed and the course of reaction in the γ-radioinduced polymerization of vinyl acetate with SO_2 between −196 and 20°C, at dose rates of 0.9×10^4 to 7.2×10^4 rad/hr. In the liquid state, the polymerization did not occur above −20°C or below −100°C, and reached a maximum value of the rate of polymerization at around −60°C. The yield increased sharply as the amount of SO_2 increased in the reaction mixture. A reaction mechanism based on intermediate free radicals was proposed. In the solid state, the maximum rate of polymerization was attained at about −150°C, and at monomer ratio of 1 to 1 in reaction mixtures. Polymerization occurred mainly in the postirradiation period. A reaction mechanism due to an active center

in the excited state is suggested. The monomer ratio of the obtained polysulfone is 1 to 1 in both the liquid and solid state reactions. Propagation steps are discussed from the viewpoint of monomer and SO_2 interactions. (BBB)

18775 THE INFLUENCE OF GAMMA RADIATION ON THE PHYSICAL PROPERTIES OF GELATIN. Hopp, V.; Wuendrich, K. (Deutsche Gelatine-Fabriken, Goeppingen, Ger.). Leder, 15: 277-83(Dec. 1964). (In German).

Gelatin powder (moisture content 13%) was irradiated with a ^{60}Co source using doses of from 0.0001 to 100 Mrad. After 1.0 Mrad gel strength decreased from 263 bloom g to liquidity at highest doses. Viscosity decreased from 93 to 20 millipoise over this interval; setting point decreased after 1.0 Mrad from 25.5 to 11.8°C at 75 Mrad; samples irradiated with 100 Mrad did not set. The pH remained constant at 4.3 until 30 Mrad; after this dose it rose slightly to 4.5 at 100 Mrad. Conductivity rose from 379 to 426 microsiemens across the range. The isoelectric point, 8.85 for non-irradiated sample, decreased after 0.1 Mrad to 7.51 after 100 Mrad dose. Gels were irradiated in a N_2 atmosphere with doses from 0.1 to 0.8 Mrad. Viscosity increased from 90 to 125 millipoise; setting point increased from 25.5°C to 26.5°C. Gel strength decreased from 260 to 222 bloom g; conductivity increased from 376 to 385 microsiemens; the isoelectric point remained essentially constant. When the gels were prepared with O_2-free water, viscosity increased from 90 to 180 millipoise, setting point from 25.7 to 27.9°C, conductivity from 374 to 382 microsiemens, isoelectric point decreased from 8.95 to 8.8, and gel strength decreased from 265 to 234 bloom g. Studies of pH were also carried out. (BBB)

18776 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. XI. RADIATION POLYMERIZATION OF THE TWO-COMPONENT SYSTEM N-VINYLSUCCINIMIDE AND SUCCINIMIDE. Hardy, Gyula; Varga Jozsef; Cser, Ferenc (Muszaki Egyetem Muanyag- es Gumiipar Tanszeke, Budapest). Magyar Kem. Foly., 71: 535-8(Dec. 1965). (In Hungarian).

The solid system N-vinylsuccinimide–succinimide is characterized by an eutectic composition with a molar ratio 8.6:1.4. The rate of solid-state polymerization increased gradually on the addition of succinimide until the eutectic composition was reached, then no change was observed. It was proved by x-ray analysis that the eutectic system consists of a mixture of the most finely dispersed crystals of the two components. This system has a maximal heterogeneous contacting surface allowing the highest mobility of the monomer molecules. This ensures the highest rate of polymerization of monomers polymerizing in the solid state according to accelerating kinetics. (auth)

18777 ON THE POLYMERIZATION OF FORMALDEHYDE IN THE LIQUID STATE. II. GAMMA RAY-INITIATED POLYMERIZATION IN A DISPERSED SYSTEM. Nakashio, Seizo; Takahashi, Kei; Ueda, Mitsuo (Sumitomo Chemical Co., Ltd., Osaka). Makromol. Chem., 89: 245-56(1965).

The kinetics of formaldehyde polymerization in a dispersed system under ^{60}Co γ irradiation was studied. Polymerization took place at −80°C in methylcyclohexane and n-heptane, using sorbitan sesquioleate as nonionic detergent. The initial rate of polymerization was only slightly dependent on the concentration of detergent, within the concentration range investigated, and on the type of dispersion medium. That is, the process was unaffected by the size and number of the monomer droplets. The intensity exponent was ~0.9 and the molecular weight of the polymer was independent of dose rate. These findings indicate that almost all of the active centers were generated in the monomer globules and that unimolecular termination was operative in the polymerization. Both the initial rate of polymerization and average degree of polymerization were independent of the amount of monomer within a certain range. However, the polymerization rate increased rapidly with increasing amount of monomer beyond about 60 wt % and approached that of bulk polymerization. The average degree of polymerization tended to diminish with increasing dose. It was observed microscopically that an increase of conversion was accompanied mainly by the increase of the number of polymer globules below about 30 wt % conversion and by growth to a larger size of polymer globules formed beyond about 30 wt % conversion. (BBB)

18778 LABELLED PRODUCTS FROM THE INTERNAL RADIOLYSIS OF LIQUID CYCLOHEXANE SATURATED WITH TRITIUM GAS. Odell, A. L.; Packer, J. E.; White, G. R. (Univ. of Auckland, N. Z.). Nature, 209: 72-3 (Jan. 1, 1966).

An investigation was made by gas chromatography of the products formed by self-irradiation of cyclohexane–tritium mixtures. Samples of cyclohexane were saturated with tritium gas. Labeled compounds formed by the self-radiolysis were determined. Results indicated that free radical reactions were not dominant. Ion-molecule reactions seemed the most likely source of the products. Tritium recoil labeling could account for only a small fraction of the products. (M.C.G.)

18779 COLLAPSE OF POLYACRYLAMIDE MOLECULE ON ELECTRON IRRADIATION. Quayle, D. V. (Derby and District Coll. of Tech., Eng.). Nature, 209: 803-4 (Feb. 19, 1966).

Particles of polyacrylamide weighing about 15×10^{-5}g were subjected to electron bombardment in an electron microscope, using electron energies of 30 to 100 kV, electron currents of 15 to 70 μamp and exposure times of 5 to 100 sec. Solubility tests and optical microscopy were carried out. The irradiated polymer readily swelled to several times its original volume, but remained quite insoluble after immersion in water for 10 days. After short exposure times, the polymer did not change visibly. Increase in exposure time produced a faint yellow color that became more intense as the exposure time increased, finally becoming opaque. Results indicated that intermolecular cross-links are formed by electron irradiation, rather than that the polymer is degraded. The collapse of single molecules of polyacrylamide in an electron beam is explained on the basis of intramolecular imidization. (H.G.D.)

18780 THE ISOTOPE SEPARATOR OF THE ROME UNIVERSITY AND ITS APPLICATION TO THE STUDY OF THE CHEMICAL REACTIONS OF ENERGETIC IONS. Ascoli, S. (CNR, Rome); Cacace, F. Nucl. Instrum. Methods, 38: 198-203(1965).

An electromagnetic isotope separator was built to study the chemical reactions of accelerated ions. A brief account is given of the general features of the instrument. The problem associated with the use of the separator for the study of chemical reactions and the results of preliminary experiments on the bombardment of organic targets with 40 kev tritium ions are discussed. (auth)

18781 A PRELIMINARY REPORT ON CHEMICAL REACTIONS WITH ACCELERATED IONS. Andersen, T.; Soerensen, G. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods, 38: 204-6(1965).

A conventional isotope separator and the new 600 kv ion accelerator in Aarhus was used for studying the chemical fate of singly and doubly charged chromium ions in crystalline potassium chromate. The results are compared with data obtained from investigation of the chemical effects following thermal neutron capture in potassium chromate. (auth)

18782 POLARIZATION ABILITY OF CATIONS AND FORMATION OF HYDROGEN PEROXIDE IN DEAERATED AQUEOUS SOLUTIONS OF SULFATES EXPOSED TO ^{60}Co GAMMA RADIATION. THE DEPENDENCE ON CONCENTRATIONS AND TEMPERATURE FOR SOLUTIONS OF Li^+, Na^+ AND Rb^+. Minc, Stefan; Wezranowski, Eugeniusz (Inst. of Nuclear Research, Warsaw). Nukleonika, 10: 741-6(1965).

The effects of hydration energy of various cations in 0.20, 0.90 and 1.50M aqueous solutions of Li, Na, and

Rb sulfates on the yield of hydrogen peroxide $G_{H_2O_2}$ in spur were examined. The deaerated aqueous solutions of sulfates exposed to gamma radiation contained acrylamide as an acceptor of the radicals formed. A dependence of the yield of hydrogen peroxide $G_{H_2O_2}$ on the nature of the cation, its concentration, and the temperature of the solution was observed. It was found, that under given conditions $G_{H_2O_2}$ decreases with the increase of the temperature of the solutions, of increases with increase of cation concentration in the solution, and the hydration energy of the cations. (auth)

18783 PRIMARY PROCESSES IN RADIATION CHEMISTRY AS STUDIED BY MASS SPECTROMETRY. V. EXCITED AND SUPEREXCITED STATES IN THE RADIOLYSIS OF TETRAHYDRONAPHTHALENE. Wincel, Henryk; Kecki, Zbigniew (Inst. of Nuclear Research, Warsaw). Nukleonika, 10: 753-64(1965).

The formation of ions and excited molecules in the initial stage of radiolysis of tetrahydronaphthalene was analyzed. Their yields were determined to be: $G(C_{10}H_{12}^+) = 4.0$ and $G(C_{10}H_{12}^*) = 4.3$. The possibility of formation of excited and superexcited molecules in the recombination process and the transformations of these molecules are discussed. The yields of products of the transformations were evaluated. (auth)

18784 THEORY OF THE RADIATION POLYMERIZATION OF INCLUSION COMPOUNDS. Temkin, A. Ya. Petrol. Chem. (USSR) (Engl. Transl.), 2: 210-18(1963).

The kinetics of the radiation polymerization of inclusion compounds is discussed. Expressions for the distribution of the polymer with respect to the length of the molecules and formulas for the mean molecular weight were obtained. During the formation of the polymer, the original distribution of channels with respect to length changes, which leads to a change in the geometrical conditions of formation of the polymer molecules. Consequently, in calculating the distribution of the molecules with respect to length, it is necessary first to determine how the original distribution of channels with respect to length changes with time. Channel is used to denote the free section. The end of the channel may either open on to the external boundary of the crystal or run into some mechanical obstruction to the growth of the chain. It is assumed that cessation of the growth of the chain takes place only when its active end reaches the end of the channel. Under these conditions, two variants are possible: the chain grows in both directions from the point of initiation and the polymer molecule always occupies the whole channel; the chain grows in one direction from the point of initiation and the polymer molecule generally occupies part of the channel. The first hypothesis corresponds to a biradical and the second to a radical or ionic polymerization mechanism. From a comparison of the formulas derived with experimental results, it followed that the growth of the polymeric chain in the channel apparently takes place in one direction from the point of initiation. It is shown that it is possible to solve this question by experiments on the polymerization of a monomer containing small amounts of inactive molecules, since the dependence of the mean molecular weight of the polymer on the concentration of impurity has different forms for the case of polymerization in one direction from the point of initiation and the case in which the chain grows in the channel in both directions from the point of initiation. (BBB)

18785 THE RADIATION-THERMAL CRACKING OF GAS-OIL. Brodskiĭ, A. M.; Lavrovskiĭ, K. P.; Makarov, D. V.; Mezentsev, A. N.; Fish, Yu. L. Petrol. Chem. (USSR) (Engl. Transl.), 2: 219-27(1963).

The chemical changes taking place in petroleum gas-oil fractions under the action of radiation from a nuclear reactor in the temperature range of radiation-thermal cracking (RTC) were studied. The radiation-chemical yields of light products and polymers were established and the changes in the chemical composition of the liquid products were studied. The physico-chemical characteristics of the products of radiation-thermal synthesis (radiation-chemical polymers) are given. All experiments were carried out at 300°C. The rate of circulation was 150 to 160 l/hr, and the pressure in the system was 3 to 3.5 atm. The starting material was a specially treated gas-oil from sulfur-free petroleum. The presence of sulfur in these experiments was undesirable in view of the formation from it of radiophosphorus through a (n,p) reaction. In the RTC process investigated, in addition to reactions of degradation and synthesis (the formation of gas and light fractions and the accumulation of radiation-chemical polymers) taking place in parallel, there was also a change in the chemical composition of the fractions boiling within the temperature range of the initial raw material. The composition of the issuing gases from the RTC of the gas-oil is given. A decrease was noted in the concentration of hydrogen and an increase in the content of heavier hydrocarbon gases as the radiation dose is increased. The decrease in the hydrogen content is explained, not by inhibition, but by the predominant decomposition in the initial stage of the paraffinic components of the starting material. At radiation doses of up to 100 Mrad, there was a linear relation between the yield of gas and the dose; at further increases in the total dose the curve began to approach a limiting figure asymptotically. Radiation-thermal cracking of gas-oil takes place under conditions at which thermal cracking does not take place. The accumulation, with olefins, of cyclenes and, particularly, cyclanes, with the predominant decomposition of the paraffins is shown. The high-boiling products formed from radiation-thermal cracking are close in ring composition to the initial gas-oil. Their highest boiling fractions contain condensation products even at 300°C. The distribution of products (gas, gasoline, and heavy fractions) in the radiation-thermal cracking of gas-oil approximates the distribution on thermal cracking. However, to obtain degrees of conversion customary in industrial thermal cracking, at the temperature of RTC investigated, practically unattainable values of total dose are necessary. (BBB)

18786 PROPERTIES OF AN UNUSUAL PHOTOPRODUCT OF U.V. IRRADIATED THYMIDYLYL-THYMIDINE. Pearson, M. L.; Ottensmeyer, F. P.; Johns, H. E. (Univ. of Toronto). Photochem. Photobiol., 4: 739-47(Sept. 1965).

Ultraviolet irradiation of thymidylyl-thymidine (TpT) resulted in the production of at least 4 chromatographically separable photoproducts. One of these, arbitrarily called TpT^4, was produced irreversibly from TpT and has a number of unusual properties. These include maximum extinction at 325 mμ and minimum at 270 mμ; fluorescence when irradiated at 254 mμ; and a marked stability to the action of venom phosphodiesterase. In addition, TpT^4 was converted by reirradiation to another unidentified photoproduct, TpT^3, which may be converted back to TpT^4 by irradiation in a wavelength-dependent manner similar to the conversion of TpT dimers back to TpT. The preparative isolation of TpT^4 by ion-exchange chromatography on DEAE cellulose and its uv, fluorescence, and ir spectra are described. TpT^4 has an ir spectrum consistent with the assumption that one of the thymine rings has been converted to a pyrimidin-2-one structure. In addition, TpT^4 appeared to have both pyrimidine rings linked together and does not contain a peroxide group as previously supposed. Spectrophotometric titration showed that TpT^4 has a pK_a of 10.75 and is unstable to prolonged treatment at extreme pH. A model structure consistent with the present data is given. This model contains the glycosidic and phosphodiester bonds intact with a 5-methylpyrimidine-2-one ring and a thymine ring joined in either linkage at the C_4 positions, with an OH at the C_4 position in the thymine ring. (BBB)

18787 CHEMISORPTION OF OXYGEN ON SOME ALKALINE EARTH OXIDES. Nelson, R. L.; Tench, A. J.; Wilkinson, R. W. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceram. Soc., No. 5, 181-98(Dec. 1965).

Chemisorption of oxygen on MgO and CaO was observed on the powders as prepared or after treatments involving mechanical agitation, γ irradiation or fast neutron irradi-

ation. By a combination of gas adsorption and electron spin resonance techniques several types of chemisorption were identified and possible mechanisms are discussed. Intrinsic paramagnetic defect centers are of importance in at least two of the mechanisms while a third is due to the presence of transition metal impurity ions. Adsorption as a result of mechanical agitation appears to occur at nonparamagnetic sites. (auth)

18788 INTERACTION OF NUCLEIC ACIDS. III. CHEMICAL LINKAGE OF THE CARCINOGEN 3,4-BENZPYRENE TO DNA INDUCED BY X RAY IRRADIATION. Rapaport, S. A.; Ts'o, Paul O. P. (Johns Hopkins Univ., Baltimore). Proc. Nat. Acad. Sci. U. S., 55: 381-7(Feb. 1966).

Experiments were performed that show that a substantial portion on the radioactivity of the ^{3}H-benzpyrene-DNA physical complex becomes linked to DNA after x irradiation. The fraction of the original ^{3}H-benzpyrene-DNA that becomes chemically linked by irradiation increases with dose up to about 35 kR where it reaches a plateau. (H.G.D.)

18789 THE ACTION OF γ-RAYS ON DEOXYRIBONUCLEOHISTONE IN SOLUTION. Lloyd, P. H.; Peacocke, A. R. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. B, 164: 40-62(Feb. 15, 1966).

Measurements were made by light scattering of the decrease, resulting from γ-irradiation, in the molecular weight and radius of gyration of deoxyribonucleohistone (DNH) in 0.7 mM phosphate buffer (pH 6.8). The number of fractures produced depended on a power of the dosage intermediate between one and two. The relative constancy of the radius of gyration at doses up to about 1 eV/P atom, while the mean molecular weight decreased, suggested that dissociation of the histone from the DNA core might be occurring. Similar measurements on DNH dissolved in 2M potassium chloride solutions showed that the DNA core was degraded during irradiation and this was confirmed by the increase observed in the width of the band that was obtained when the DNH was centrifuged to equilibrium in a density-gradient of CsCl. Irradiation also caused denaturation, since the buoyant density of the DNA component of the DNH increased and there was a decrease in ultraviolet hypochromicity, as determined after heating the irradiated solutions. From integral sedimentation-distribution curves at zero concentration it was inferred that all the DNH molecules, apart from some aggregated material, had undergone the same fractional decrease in sedimentation coefficient, and hence in molecular weight, irrespective of their original size. The irradiated DNH also showed an increased anionic electrophoretic mobility, which is consistent with the loss of a cationic fragment from the molecule. Calculations showed that the observed molecular-weight changes could be explained by a mechanism that combines dissociation of histone by a one-hit process and degradation of the DNA by a two-hit process. It is suggested that an attack on the DNA, resulting in the breakage of one of the two chains, and the consequent disorganization of the helix in the vicinity of the break, would be the most likely cause of dissociation of the histone. (auth)

18790 SENSITIZING AND PROTECTIVE ACTION OF MICROQUANTITIES OF OsO_4 ON RADIOLYTIC OXIDATION IN AQUEOUS SOLUTION. Halessinsky, M.; Dran, J. -C. (Univ., Paris). Progr. Biochem. Pharmacol., 1: 99-106(1965).

Osmium tetroxide in acid solution is not modified by ^{60}Co γ rays, but its presence alters the molecular yields (H_2 and H_2O_2) of the decomposition of water. OsO_4 accelerates the radiolytic oxidation of various solutes in presence of oxygen because of its sensitizing effect on oxidation by H_2O_2. The addition of very small amounts (7×10^{-6} M) to acid solutions of Te^{IV} increases $G(Te^{VI})$ from 3.2 to 6.0. Under certain conditions, OsO_4 suppresses the after-effect normally observed after exposure of Pt^{II} or arsenite solutions to γ rays; the oxidation yield is then equal to the total yield (including after-effect) which would be measured in absence of OsO_4. In the case of phosphites, the catalyst sensitizes the oxidation reaction at pH < 2, but has a protective effect at higher pH values, suppressing the chain reaction which characterizes the radiolytic oxydation of phosphites. A general mechanism is proposed to account for the above phenomena. (auth)

18791 ULTRA-VIOLET INDUCED CHANGES OF ELECTRON SPIN RESONANCE SPECTRA OF X-IRRADIATED BIOCHEMICALS. Moenig, H.; Koch, R. (Univ., Freiburg i. B.). Progr. Biochem. Pharmacol., 1: 107-11 (1965).

Polycrystalline samples of methionine and bovine serum albumin (BSA) were sealed under vacuum and exposed to 100 kR x radiation followed by exposure to ultraviolet radiation. The electron spin resonance signals from the irradiated samples were recorded and the spectrum compared to that of samples exposed to x radiation only or to that of samples exposed to ultraviolet radiation of longer wave lengths. The behavior of irradiated methionine and BSA were found to be quite different. Possible reaction mechanisms are discussed. (C.H.)

18792 INFLUENCE OF SMALL DOSES OF IONIZING RADIATION ON CHEMICAL TESTS AND ON ELECTRIC CONDUCTIVITY OF PLASMA. Giordano, A. (Univ., Pavia, Italy). Radiobiol. Radioterap. Fis. Med., 20: 291-300(July-Aug. 1965). (In Italian).

The sedimentation rate of a solution of bismuth oxychloride was observed before and just after irradiation with 6 R. Irradiation caused significant delay. Therefore it is suggested that natural background radiation may influence the behavior of chemical tests. (auth)

18793 CHEMICAL DOSIMETRY OF LOW-LEVEL γ RAYS USING RADIOACTIVE IRON. Hasegawa, Kunihiko (Shizuoka Univ., Japan). Radioisotopes, 15: 69-72(1966).

To investigate the measurement of a low level gamma dose, 0.1N sulfuric acid solution containing Fe(II) and ^{59}Fe(II) (as a tracer) was irradiated with ^{60}Co gamma rays. An ion exchange column of titanium phosphate was used for separating ^{59}Fe(II) from ^{59}Fe(III). The amount of ^{59}Fe(III) produced by irradiation was found to increase linearly with radiation dose. G-value was 23.6 ± 0.4. For the Fe(II) concentration of 2×10^{-4}M, a fairly good result was obtained within the range of dose of 200 ~ 800 rads. (auth)

18794 pH INDUCED TRANSITION OF POLYMETHACRYLIC ACID IN AQUEOUS SOLUTION. NOTE II. STEREOREGULAR POLYACIDS. Barone, Guido; Crescenzi, Vittorio; Quadrifoglio, Franco (Univ., Naples. Centro Nazionale di Chimica delle Macromolecole, Naples). Ric. Sci. Rend., Sez. A, 8: 1069-82(Sept.-Oct. 1965).

A set of experimental data regarding some physicochemical solution properties of poly(methacrylic) acid (PMA) samples prepared by irradiation of methacrylic acid are reported. The results supported the view that PMA in aqueous solution undergoes a transition with a distinct cooperative character from a compact conformation to an open solvated one. In the case of the different PMA samples studied, the transition takes place at a nearly identical critical value of the degree of neutralization. The basis for an interpretation of the mechanism of PMA conformational transition is briefly discussed. (auth)

18795 STUDIES IN RADIATION POLYMERIZATION. VI. RADIATION POLYMERIZATION OF CHLOROPRENE. Ivanov, V. S.; Medvedeva, Y. V.; Ivanova, L. I. Vestn. Leningr. Univ., No. 22, Ser. Fiz. Khim., No. 4, 154-64(1965). (In Russian).

The radiation polymerization of chloroprene in bulk using ^{60}Co γ rays under conditions excluding autopolymerization was studied. Soluble α-polychloroprene was formed by the radiation only in the presence of a stabilizer. The influence of dose, dose rate, temperature, type and concentration of stabilizers, and gaseous sensitizers on the yield, molecular weight, and some properties of the polymers was determined. The radiation polymerization of chloroprene at 20°C proceeded through a free-radical mechanism. An ionic mechanism competing with the free-radical mechanism revealed itself as the temperature

dropped. T_g of radiation-produced polychloroprenes is from −45 to −54°C. The physical-mechanical characteristics of unfilled vulcanizate are of the same order of neoprene GN. The influence of the conditions of polymerization on the dimer yield was determined. (auth)

18796 NEW METHOD FOR GRAFTING SIMULTANEOUSLY BUTADIENE AND ACRYLONITRILE ONTO CELLULOSE BY IONIZING RADIATION. Tashiro, Shigeki (to Japanese Association for Radiation Research on Polymers). Japanese Patent 1964-559. Jan. 13, 1965. Filed Jan. 20, 1962.

The method proposed is an improvement on the previous patent Shōwa 36-21928. Using the appropriate compositions of the monomer solution, the products with highly grafted butadiene and acrylonitrile are obtained. The grafting process consists of contacting cellulose with a mixture of butadiene acrylonitrile with methanol as the solvent and irradiating the mixture. The following compositions (in weight) were used: (butadiene + acrylonitrile)/(butadiene + acrylonitrile + solvent) × 100 = 40 − 90%, and butadiene/(butadiene + acrylonitrile) × 100 = 3 − 90%. (NSA of Japan)

18797 METHOD FOR PREPARATION OF SELF-LUMINESCENT SUBSTANCES. Murashima, Toru (Dainippon Shinroihi Co., Ltd.). Japanese Patent 1964-2523. Feb. 10, 1965. Filed Mar. 9, 1962.

A self-luminescent substance is prepared by coating the surface of a luminescent body with Pm-147 adsorbed on a silica aerogel carrier. Promethium hydroxide is precipitated on the surface of silica aerogel by dipping the silica aerogel in the aqueous solution of a promethium salt. Then ZnS, Cu, and methanol are added to the silica aerogel and dispersed uniformly by sufficient stirring; and the mixture is dried by evaporating the methanol. (NSA of Japan)

18798 METHOD FOR GRAFTING BUTADIENE AND STYRENE ONTO CELLULOSE BY IONIZING RADIATION. Tashiro, Shigeki (to Japanese Association for Radiation Research on Polymers). Japanese Patent 1964-3718. Feb. 26, 1965. Filed Nov. 20, 1961.

When using the proposed method, a cellulose grafted with 10000−20000% of styrene and butadiene is easily obtained; then homopolymer polymerized with no grafting is scarcely produced. When applied to cellulose fiber, the fiber grafted with 10000−20000% of styrene and butadiene still maintains the fiber. This is in sharp contrast with the cellulose fiber, grafted with only 1000% or so, of other vinyl monomer, which loses the fiber. In grafting styrene and butadiene onto cellulose, cellulose is contacted with a mixture in methanol of styrene and 1-25 wt % butadiene; then, the whole is irradiated with ionizing radiation either in the presence or absence of air. (NSA of Japan)

18799 NEW METHOD FOR GRAFTING SIMULTANEOUSLY STYRENE AND ACRYLONITRILE ONTO CELLULOSE BY IONIZING RADIATION. Tashiro, Shigeki (to Japanese Association for Radiation Research on Polymers). Japanese Patent 1964-3719. Feb. 26, 1965. Filed Jan. 20, 1962.

A method employing ionizing radiation is proposed for grafting styrene and acrylonitrile onto cellulose. Using this method, a higher degree of grafting can be obtained by employing an appropriate mixture of the components than by irradiating the components separately. The grafting process consists of contacting cellulose with a mixture of styrene (5−55%) and acrylonitrile (5−55%) with (25−75%) methanol as the solvent and irradiating in the presence or absence of air with a radiation dose of $1 \times 10^4 - 5 \times 10^6$ r. (TCO)

18800 METHOD FOR PREVENTING THE RADIATION DAMAGE OF THE TBP SOLVENT USING IN FUEL REPROCESSING. Kikuchi, Seishi (to Japan Atomic Energy Research Inst.). Japanese Patent 1964-3878. Mar. 1, 1965. Filed Dec. 12, 1962.

In the reprocessing of nuclear fuels by solvent extraction, the solvent is decomposed considerably by the radiation from the fission products resulting in the lowering of the extraction efficiency and of the decontamination factor. Consequently, it becomes necessary to discard the costly solvent after short periods of use or to remove the decomposition products from the damaged solvent. In the method proposed, tetramethylthiuram disulfide, a radical stabilizer, is added to the solvent (tributyl phosphate) to inhibit radiation damage. (NSA of Japan)

Radiochemistry

See also Separation Processes and Procedures

Refer also to abstract 20339.

18801 (CEA-R-2858) SYNTHESE D'UN HYDROCARBURE AROMATIQUE POLYCYCLIQUE MARQUE AU ^{14}C: LE DIBENZO (b, d e f) CHRYSENE ^{14}C-7, 14. (Synthesis of a Polycyclic Aromatic Hydrocarbon Labeled with ^{14}C: (b, d e f) Dibenzo-Chrysene ^{14}C-7, 14). Chatelain, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 68p. Dep. mn.

(b,def) Dibenzochrysene(^{14}C-7,14) was synthesized from radioactive carbon dioxide and the organic magnesium compound derived from 1,5-dibromonaphthalene. The product was purified by a very precise series of fractionated chromatographs on alumina having a chromatographic activity. This necessitated the development of a special technique. (auth)

18802 (CEA-R-2917) ETUDE PRELIMINAIRE A LA PREPARATION D'^{232}U PAR IRRADIATION DE ^{231}Pa. (Preliminary Study of the Preparation of ^{232}U by Irradiation of ^{231}Pa). Guillot, Philippe (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec. 1965. 32p. Dep. mn.

A bibliography on the preparation of uranium-232 is presented. This even-even isotope of uranium is suitable for radioactive tracer, neutron source through (α,n) reaction, and heat source applications. The irradiation of protactinium-231, chemical separation, and purification of uranium were studied. (23 references). (auth)

18803 (EUR-2527.d) SYNTHESE VON KOHLENSTOFF-14-MARKIERTEN TERPHENYLEN. (Synthesis of ^{14}C-Labeled Terphenyls). Fischer, E.; Hafferl, W.; Schmidl, M. (Battelle Institut E. V., Frankfurt am Main (West Germany)). 1965. 32p. Dep. mn.

Tests were made on the synthesis of ^{14}C-labeled o- and p-terphenyl. The terphenyls synthesized were supposed to have the labeling partly distributed in one of the rings and partly only in one given position. The results showed that ^{14}C-labeled terphenyls can be produced by reaction of aryl lithium compounds with cyclic ketones. Both the reaction of commercial uniformly labeled (U)-^{14}C-bromobenzene, or (U)-^{14}C-phenyl lithium produced from it, with phenylcyclohexanone and of commercial 1-^{14}C-cyclohexanone with diphenyl lithium yielded diphenyl cyclohexanols or diphenylyl cyclohexanols which could be converted into the correspondingly marked terphenyls by catalytic dehydration and dehydrogenation. So far the following have been synthesized: (1,2,3,4,5,6)-^{14}C-o-terphenyl, (1,2,3,4,5,6)-^{14}C-p-terphenyl, 1-^{14}C-o-terphenyl, and 1-^{14}C-p-terphenyl. The synthesis yield, the reaction being carried out on the 10- to 25-millimol scale, was mostly between 40 and 60%. The specific activity of the labeled terphenyls ranged up to 0.25 mC/m mole; higher values can be attained by using higher-activity starting materials. For specific labeling in the 2-, 3-, and 4-position of o- and p-terphenyls, starting substances such as 4-^{14}C bromobenzene were required. Inactive preliminary tests were performed on the synthesis of 4-^{14}C-bromobenzene from commercial 1-^{14}C-aniline. Methods for the preparation of terphenyls labeled in the central ring are being elaborated. (auth)

18804 (SORIN-34) PRODUCTION DES RADIOELEMENTS ET DES MOLECULES MARQUEES A USAGE MEDICAL EN ITALIE. (Production of Radioelements and Labeled Molecules for Medical Use in Italy). Cesoni, G.; Rosa, U.; Vacchelli, G. (Societa Ricerche Impianti Nucleari, Sluggia (Italy). Centro Ricerche Nucleari). 1964. 15p. (CONF-640417-1). Dep. mn.

From European Meeting of Producers of Radioisotope, Saclay.

A brief survey is given of the facilities for the production of radioisotopes and labeled molecules at SORIN. The radioisotopes produced commercially since 1963 and the labeled molecules and special products are tabulated. (J.S.R.)

18805 (SZS-12(1965)) DIE BESTIMMUNG DES THORIUMS IM HARN. (Determination of Thorium in Urine). Sommer, J. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Dec. 1965. 23p. Dep. mn.

A fluorometric and a colorimetric method for the determination of thorium are compared. Procedures for both methods are given. The thorium is separated from the urine by an alkaline earth phosphate precipitation and from inorganic materials by a lanthanum fluoride precipitation and a TTA-extraction. After addition of 5, 10, 50, and 100/μg Th yields were 86 and 87%, standard deviations ±7 and ±8%, and detection limits 2.3 and 2.9/μg for the fluorometric and the colorimetric method, respectively. (auth)

18806 ACTIVATION DEVICE FOR OBTAINING ACTIVE DEPOSIT OF THE THORON ON THIN WIRE. Ujhelyi, Cs.; Berenyi, D. (Inst. of Nuclear Research, Debrecen). Acta Phys. Acad. Sci. Hung., 20: 189-91(1966).

An activation device designed for obtaining ThB + C + C′ on thin wire is described. The device consists of a stainless steel vessel containing a Rn–Th source in hydrated ferric oxide preparation, a wire stretched by a steel spring, and an unscrewable plexiglas plug. (L.B.S.)

18807 USE OF SECONDARY NUCLEAR REACTIONS IN RADIOCHEMISTRY. Aumann, D. C. (Technische Hochschule, Munich). Atompraxis, 12: 77-80(Feb. 1966). (In German).

Studies in the field of radiochemistry, which are based on secondary nuclear reactions, are surveyed. Particular attention is paid to the application of secondary nuclear reactions in radiochemical work. Publications in this field up to April 1965 are listed. (113 references). (auth)

18808 ISOTOPIC EXCHANGE OF OXYGEN IN SILVER FILMS. Boreskov, G. K.; Khasin, A. V.; Starostina, T. S. (Inst. of Catalysis, Academy of Sciences, Siberian SSR). Dokl. Akad. Nauk SSSR, 164: 606-9(Sept. 21, 1965). (In Russian).

In order to determine the nature of the bond prevailing between oxygen adsorbed on the surface of silver films and the Ag atoms, kinetics of the isotopic exchange reaction between the adsorbed and gaseous oxygen during the homomolecular exchange process were investigated. The experiments were carried out in a static vacuum system, determining the isotopic composition of oxygen by mass spectroscopy, and using a vacuum-evaporated Ag film for the adsorption. The film condensed at 20°C had a surface of 120 to 160 cm^2, that condensed at −195°C and subsequently heated had a surface of 250 cm^2. The oxygen used was enriched, containing 43% of ^{18}O; the tests were carried out at 200 and 250°C with the −195 and 20°-films, respectively. Most of the adsorption was completed within one-half hour; at that time the low-temperature film adsorbed 0.7 layer and the room-temperature film 2 to 3 layers, assuming that 1.2×10^{15} O atoms are required to cover 1 cm^2 of Ag. The results indicated that the ^{18}O concentration in the gas phase decreases. The specific exchange rate data indicate that the two types of film behave identically. An apparent activation energy of 31 ± 2 kcal/mole was found; the order of magnitude of the exchange with respect to pressure was 0.3. The homomolecular exchange rate and activation energy of O were determined at 225, 250, and 300°C and at pressures of 0.1 and 0.7 mm of Hg; the results agreed with the isotopic exchange data. The adsorbed O was found to be very mobile. (TTT)

18809 A CYCLOTRON METHOD FOR THE PRODUCTION OF ^{18}F. Clark, J. C.; Silvester, D. J. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop., 17: 151-4(Mar. 1966).

^{18}F was produced, with yields of up to 40 mC/hr, by the bombardment of water contained in a suitable target held in the external α beam of a 30-Mev cyclotron. A method is described, which is in routine use to produce samples for medical research purposes. (auth)

18810 SYNTHESIS OF ^{18}O-LABELED HYDROGEN PEROXIDE IN $H_2{}^{16}O$. Anbar, M.; Baruch, Z.; Meyerstein, D. (Weizmann Inst. of Science, Rehovoth, Israel. Soreq Nuclear Research Centre, Rehovoth, Israel). Int. J. Appl. Radiat. Isotop., 17: 256(Apr. 1966).

The synthesis of ^{18}O-labeled H_2O_2 by auto-oxidation of hydroxylamine in the presence of perchlorate ions is described. The overall yield based on the $^{18}O_2$ used was 25 to 30%. Isotopic composition was identical within 1% with that of the oxygen used. Yields on six tests were reproducible within ±10%, and the H_2O_2 obtained was free from impurities and could be stored for weeks in a polyethylene container without decomposition. (H.G.D.)

18811 SOME ASPECTS OF THE PREPARATION OF ^{86}Rb. Yang, Mo-Hsiung; Yeh, Si-Jung (National Tsing Hua Univ., Taiwan). J. Chin. Chem. Soc. (Taiwan), Ser. II, 12: 97-106(Sept. 30, 1965).

The purification of ^{86}Rb was studied. Ten grams of rubidium chloride were irradiated in the THOR for 120 hr at a neutron flux of 3×10^{12} n/cm^2-sec. After the anionic species induced by nuclear reactions were removed by anion exchange the trace amount of cesium in the irradiated target was separated from ^{86}Rb by ion exchange. Dowex 50w × 4(200 to 400 mesh) was used as the exchange resin and dilute hydrochloric acid of varying concentrations was employed as the eluant. Optimum conditions for separating a large quantity of ^{86}Rb from the trace amounts of ^{134}Cs was investigated by varying column ratios, hydrochloric acid concentrations, and flow rates. An inorganic exchanger was also tried for comparison. (auth)

18812 ENRICHMENT OF ^{51}Cr BY THE SZILARD-CHALMERS PROCESS. II. Yeh, Si-Jung; Tsai, Chung-Hsiung (National Tsing Hua Univ., Taiwan). J. Chin. Chem. Soc. (Taiwan), Ser. II, 12: 107-15(Sept. 30, 1965).

Enrichment of chromium was studied by means of the Szilard-Chalmers process. Potassium chromate was used as the target material. The recoil chromium was separated from the target by three different methods, which gave different enrichment factors in the range from 650 to 1400. The relation between irradiation time and enrichment factor was studied. It was found that the enrichment factor decreases with an increase in irradiation time. The effect of cooling time on the enrichment factor was also studied. (auth)

18813 LIGHT EMISSION FROM AQUEOUS SOLUTIONS OF T_2O. Czapski, Gideon; Katakis, D. (Nuclear Research Center Democritos, Athens). J. Phys. Chem., 70: 637-40(Mar. 1966).

Light emission was measured from aqueous solutions of T_2O (1 C/ml). It is shown that the emission is unquenchable by a large variety of solutes, up to high concentrations. Using solvents other than water had no effect on the spectral distribution of light emission. The light was emitted with $G(h\nu) \leq 10^{-5}$. The results seemed to indicate that the emitting species do not participate in chemical reactions with solutes. They may be their precursors. The light may originate from bremsstrahlung or from hot He^+. (auth)

18814 RECOIL TRITIUM REACTIONS WITH BENZENE: THE ROLE OF THE CYCLOHEXADIENYL-t RADICAL. Garland, John K.; Rowland, F. S. (Univ. of Kansas, Lawrence. Univ. of California, Irvine). J. Phys. Chem., 70: 735-43(Mar. 1966).

Recoil tritium atoms reacted with gaseous benzene to form only two important hot products, HT and benzene-t, in the ratio of approximately 20:95. The presence or absence of scavenger molecules had relatively little effect on the yields, indicating that only a small fraction of the recoil atoms fail to react while still possessing extra energy. Comparable reactions in the liquid phase resulted in the formation of HT–benzene-t in the ratio of approximately 20:58. Both 1,3-cyclohexadiene-t and 1,4-cyclohexadiene-t were found in liquid-phase experiments in small

yield, and a substantial fraction of the tritium radioactivity occurred in the form of polymeric materials of low volatility. The product yields in the gaseous and liquid phases differed because of varying rates of collisional deexcitation for cyclohexadienyl-t radicals formed through the hot addition of tritium atoms to benzene. The radicals stabilized in such liquid-phase collisions were subsequently found as cyclohexadiene-t or in polymeric forms, but decomposed to benzene-t in the gas phase. The observation of appreciable yields of polymeric tritiated product permitted clarification of the explanations of the yield vs mole fraction curves obtained from recoil tritium reactions with binary mixtures containing aromatic compounds. (auth)

18815 PURIFICATION OF RADIOIODINE-LABELED BENGAL ROSE FROM THE ADMIXTURE OF NONBOUND RADIOIODINE. Denisov, E. N.; Matveenko, E. G. (Inst. of Medical Radiology, Academy of Medical Sciences, USSR). Med. Radiol., 10: No. 11, 65-6(Nov. 1965). (In Russian).

A method of purifying commercial radioiodine-labeled bengal rose from the admixture of nonbound radioiodine (from 9.28 to 0.35%) is described. The purified preparation is more resistant to sterilization by boiling than the nonpurified stain. (auth)

18816 ION DIFFUSION: III. THE EFFECT OF SOIL COMPACTION ON SELF DIFFUSION OF ^{86}Rb–^{89}Sr. Phillips, R. E.; Brown, D. A. (Arkansas Agricultural Experiment Station, Fayetteville). Soil Sci. Soc. Amer., Proc., 29: 657-61(Nov.-Dec. 1965).

Self diffusion coefficients of ^{86}Rb and ^{89}Sr diffusing in Dundee silt loam soil and of ^{90}Sr diffusing in Sharkey clay soil were measured at several soil bulk densities. The relationship between soil bulk density and self diffusion coefficients was found to be curvilinear. The soils were prepared as homoionic systems and the exchange complex was saturated with one symmetry value of either Rb or Sr and washed free of salts. Maximum self diffusion coefficients occurred at soil bulk densities of 1.58 and 1.31 g/cc for ^{89}Sr self diffusing in Dundee silt loam and Sharkey clay, respectively, and a bulk density of 1.30 g/cc for ^{86}Rb self diffusing in Dundee silt loam. The ratio of the maximum to the minimum self diffusion coefficients were 1.40, 1.25, and 1.17 for ^{89}Sr and ^{86}Rb diffusing in Dundee silt loam and ^{89}Sr diffusing in Sharkey clay, respectively. The magnitude of self diffusion coefficients measured in soil that was compacted, saturated with water, and then drained to a given volumetric water content were approximately one-half those determined in soil that contained the same volumetric water content at the time of compaction and that received no further treatment prior to the determination of the self diffusion coefficients. (auth)

18817 SYNTHESIS OF RADIOACTIVELY LABELED COMPOUNDS. XIV. SYNTHESIS OF α-N-$^{14}CH_3$-ORNITHINE AND δ-N-$^{14}CH_3$-ORNITHINE. Neumann, D.; Schroeter, H.-B. (Deutsche Akademie der Wissenschaften zu Berlin, Halle/Saale, Ger.). Z. Chem., 5: 385-6(Oct. 1965). (In German).

The preparation of α-toluenesulfonylornithine was carried out under Schotten-Baumann conditions from ornithine hydrochloride and toluenesulfonyl chloride. Thus tosylornithine was then dissolved in 5% NaOH and sealed into a vessel with $^{14}CH_3I$; then it was heated 1 hr at 77–80°C with shaking. It was cooled to 0°C, taken to pH 1 with 5N HCl, and the oil that separated, which solidified in the refrigerator, was used immediately to prepare the α-$^{14}CH_3$-ornithine by hydrolysis with 35% HCl 18 hr at 100°C. The reaction mixture was cooled to 0°C and the filtrate was evaporated. The product was separated from unreacted ornithine by paper chromatography (80%, 1.02×10^9 c = mp/min-mmole). For the other compound, ornithuric acid was hydrolyzed to α-benzoylornithine in $Ba(OH)_2$ solution. This was converted to α-benzoyl-δ-toluenesulfonylornithine under modified Schotten-Baumann conditions. The product was methylated with $^{14}CH_3I$ in aqueous solution at 80°C for 1 hr by shaking. The product separated as an oil which solidified and was hydrolyzed to δ-$^{14}CH_3$-ornithine and was purified as above (68%, 9.4×10^8 c = mp/min-mmole). (BBB)

18818 METHOD OF PREPARING A GAMMA RADIATION MATERIAL. Baldwin, George C.; Neissel, John P.; Tonks, Lewi (to General Electric Co.). U. S. Patent 3,234,099. Feb. 8, 1966. Filed Feb. 6, 1963.

A method is described for producing a gamma source material for use in a source having an output characterized by energy, directionality, and coherence and operated by means of a stimulated-emission photon-chain reaction. The source material is prepared by selecting a relatively stable target isotope characterized by a relatively large cross section for producing an upper isomeric state of the desired isotope and chemically combining the target isotope to form a particular chemical compound having covalent bonding. The target isotope compound is irradiated with neutron particles to rupture the chemical bond forming substances including the desired isotope; and subsequently, the desired isotope is isolated from the other substances to obtain a highly concentrated form of the desired isotope. A whisker shaped single crystalline solid structure is grown from the desired isotope. The crystal properties are characterized by high relative probability for the crystal to undergo a particular mode of vibration in response to absorbed recoil energy corresponding to the momentum of emission of gamma radiation within the crystalline structure. The method is particularly applicable to the preparation of the isotope ^{68}Zn from ^{66}Zn. (B.L.M.)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

18819 (AAEC/E-143) LABORATORY DEVELOPMENT OF THE GRIND-LEACH PROCESS FOR THE H.T.G.C.R. FUEL CYCLE. PART I. DISSOLUTION OF URANIA–THORIA FUEL PARTICLES IN NITRIC ACID SOLUTIONS. Farrell, M. S.; Isaacs, S. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sept. 1965. 24p. Dep. mn.

The dissolution of 5 wt % UO_2–ThO_2 fuel particles in nitric acid–fluoride solutions was found to be a function of the ThO_2 dissolution rate. The ThO_2 dissolution rate has an apparent first order dependency on nitric acid concentration and a fractional order dependency on fluoride ion concentration. The apparent activation energy of the dissolution of the ThO_2 in 13M nitric acid–0.05M fluoride is 19 kcal/mole. The presence of metal ions such as zirconium, aluminum, and beryllium inhibited the dissolution of thoria. The order of inhibiting power was Zr(IV) > Al(III) > Be(II) and this order was the same as the stability of their simplest fluoro–complexes. The addition of small quantities of sulfate also seriously inhibited the dissolution, precipitating thorium as $Th(SO_4)_2 \cdot 4H_2O$ and quantitatively removing the fluoride. (auth)

18820 (ANL-6992) ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 9. COMPUTER PROGRAMS FOR ALLOY-FUEL PROCESS CALCULATIONS. Holmes, John T.; Ramaswami, D. (Argonne National Lab., Ill.). Dec. 1965. Contract W-31-109-eng-38. 67p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

In the processing of uranium alloy fuels, the metal is chlorinated in a bed of alumina particles fluidized by hydrogen chloride gas. The uranium is separated in this step since the alloying metal chlorides are relatively volatile and leave the fluid bed. In the second step, the nonvolatile uranium chlorides are fluorinated with anhydrous hydrogen fluoride and fluorine to give uranium hexafluoride, which is volatile and thus separated from the alumina. During the process studies, three digital-computer programs were developed to calculate material balances and to process experimental data. In the first program, material balances for the hydrochlorination step were cal-

culated for a conceptual plant assuming values for alloy processing rates, equipment efficiencies, and input material flows. The calculated quantities are basic for economic evaluation studies of the hydrochlorination process. In the second program, pressure, temperature, and flowchart readings from a hydrochlorination-fluorination experiment were used as computer input data from which values of reaction rates, gas utilization, and concentrations were calculated. In the third program, uranium material balances were computed from analytical data, weight, and volumes of materials. Each computer program and an illustrative calculation are presented. The three programs are applicable to other processes, such as the decladding of zirconium or aluminum from low-enriched uranium dioxide fuels. Computer programs useful in the above applications for data correlation and for predicting properties of materials are outlined briefly. (auth)

18821 (ANL–7077) LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART IX. THE FLUID-BED FLUORINATION OF PLUTONIUM-CONTAINING SIMULATED OXIDIC NUCLEAR FUEL IN A 1 1/2-INCH-DIAMETER REACTOR. Jarry, R. L.; Hariharan, A. V.; Fischer, J.; Steindler, M. J.; Stockbar, J. J.; Baker, T. D.; Gunther, W. H.; Redding, G. W. (Argonne National Lab., Ill.). Dec. 1965. Contract W-31-109-eng-38. 48p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Fluid-bed fluorination of simulated oxidic nuclear fuels containing plutonium was investigated. Work was performed to determine the best reaction conditions for the conversion of the uranium and plutonium content of the simulated nuclear fuel to their respective hexafluorides. The experimental work involved the fluid-bed fluorination of mixtures containing U_3O_8, PuO_2, nonradioactive fission-product (F.P.) element oxides, and alumina. The uranium-to-plutonium weight ratio in the mixtures was 1000:4, and the uranium-to-alumina weight ratio was 1:2. The F. P. mixture contained several oxides. The results showed that more than 99% of the uranium could be removed from the alumina bed at reaction temperatures of 450-500°C. However, a temperature of 550°C and a reaction time of 10 hr were needed to satisfactorily remove plutonium from the alumina bed. A 20-hr fluorination, employing periods of 5 hr at 450°C, 5 hr at 500°C, and 10 hr at 550°C, resulted in the removal of 96–98% of the plutonium from the alumina. The recovery of plutonium can be further increased to >99% by reuse of the alumina bed for several additions and fluorinations of the U_3O_8–PuO_2–F.P. mixture. Plutonium retention on the alumina was affected by the flowrate of the fluorinating gas and by the quantity of fission products or plutonium in the solid reaction mixture. (P.C.H.)

18822 (BNWL–189) UCOST—A COMPUTER CODE FOR CALCULATING THE COST OF ENRICHED URANIUM. Deonigi, D. E.; Eschbach, E. A.; Kanninen, M. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1966. Contract AT(45-1)-1830. 113p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The UCOST code provides a means of calculating the cost of uranium of any enrichment level of ^{235}U in ^{238}U, based on a specified feed composition and cost, specified separative duty cost, and specified or optimum tails composition. The code can produce a schedule of costs, the theoretical burnup costs, and can provide toll enrichment costs for toll enrichment situations, as well as predict the present USAEC optimum price schedule. Examples of current and generalized price schedules, tables, and graphs are appended. (auth)

18823 (DP–1022) PERFORMANCE OF MIXER-SETTLERS IN THE THOREX PROCESS. Kishbaugh, A. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Feb. 1966. Contract AT(07-2)-1. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The capacity of the mixer-settlers in the chemical separations plant normally used for processing enriched uranium was found to be approximately 3000 pounds of thorium per day when using the dilute Thorex process to separate ^{233}U from dissolved thoria and fission products. (auth)

18824 (EURAEC–1536) REPROCESSING OF IRRADIATED FUELS. Quarterly Report No. 21, April 1–June 30, 1965. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Contract 004-64-4RCIB(RD). 98p. (EUR–2685; R–2357). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The reprocessing cycle of ceramics ($(U,Pu)O_2$) based on oxidation-hydrofluorination and fluorination with ClF_3 and F_2 was studied. The tests performed at Pu concentrations of 3 to 20% do not indicate that difficulties will be encountered with regard to Pu volatilization from high-enrichment mixed oxides. Tests of UO_2 reactions with ClF_3 show that the rate at which UF_6 is formed from powders is in agreement with the reaction kinetics of spherical solids whose surface areas decrease with time. Work on a scale of 500 g yielded data on the factors which influence the reaction of UO_2 and ClF_3. Various reagents were used to convert the compacted UC into powder form, in particular, water vapor, CO_2 and a mixture of O_2 and HF. HF was found to be most suitable for effecting a complete chemical conversion. A series of tests was carried out which illustrates the efficiency of venturi- and spray-type scrubbers for eliminating the fluorinating agents (HF, F_2, ClF_3 and UF_6) before release of the gaseous effluents through absolute ventilation filters. The absorption of UF_6 on NaF was carried out by gradual saturation. PuF_4 and UF_4 can be converted into soluble UO_2F_2 and (precipitated) PuO_2 by means of alkaline nitrates. This conversion must be regarded as instantaneous. (J.R.D.)

18825 (KFK–365) SYSTEMATISCHE UNTERSUCHUNG EINER GASCHROMATOGRAPHISCHEN TRENNUNG VON XENON UND KRYPTON SOWIE BESTIMMUNG EINIGER KERNDATEN DES ^{90}Kr. (Systematic Study of Gas Chromatographic Separation of Xenon and Krypton as Well as Determination of Nuclear Data of ^{90}Kr). Lepold, Manfred F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Nov. 1965. 65p. Dep. mn.

The values for the constants in the Langmuir absorption isotherms for Kr and Xe on activated charcoal were determined using radioactive tracer isotopes. The penetration times of Kr and Xe through a chromatographic column with an activated charcoal filling were determined and the widths of the elution waves appearing were measured. The Van-Beemter curves were therefore obtained. It was found that the experimentally determined values for the appearance time of the concentration maxima of Kr and Xe agree well with the values to be expected from theory. From the theory of gas chromatography, the definition for a separation factor was derived. A research installation for the production, separation, and investigation of a short-lived fission gas was developed. Some decay data of the 33-second ^{90}Kr were determined. (tr-auth)

18826 (UJV–1441) LABORATORNI EXTRAKCNI LINKA NA REGENERACI OZARENEHO JADERNEHO PALIVA. (A Laboratory Extraction Equipment for the Regeneration of Irradiated Fuel). Sraier, V. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1966. 16p. Dep. mn.

The proposed extraction equipment with three extraction cycles has a capacity of ca 1 kg of natural or slightly enriched uranium. The equipment is to be used for research on processes for regeneration of irradiated fuel from the dissolution of elements to the preparation of solutions of the regenerated fission materials. One part of this equipment is an analytical link, which will be used also for the analyses of solutions from the semi-pilot extraction equipment, placed in hot-cells. (auth)

18827 SEPARATION OF TRIVALENT RARE EARTHS PLUS Sc(III) FROM Al, Ga, In, Tl, Fe, Ti, U AND OTHER ELEMENTS BY CATION-EXCHANGE CHROMATOGRAPHY. Strelow, F. W. E. (South African Council for Scientific and Industrial Research, Pretoria). Anal. Chim. Acta, 34: 387-93(Apr. 1966).

A method is presented for the quantitative separation of the trivalent rare earths plus Sc(III) as a group from Al(III), Ga(III), In(III), Tl(III), Fe(III), Ti(IV), U(VI), Be(II), Mn(II),

Co(II), Cu(II), Ni(II), Zn(II), and Cd(II). These elements can be eluted from a cation-exchange column with 1.75N HCl, while the rare earth group elements are retained. Numerous other elements not investigated have low distribution coefficients in 1.75N HCl and therefore should be separated by the same procedure; Th(IV) is retained by the column when the rare earths are eluted with 3.0N HCl. The only elements which partially accompany the rare earths plus Sc(III) are Zr(IV), Hf(IV), Sr(II), and Ba(II); these have to be separated by special procedures. The method is suitable for accurate reference analysis over a wide range of concentrations. (auth)

18828 THE SEPARATION OF ZIRCONIUM AND HAFNIUM BY LIQUID-LIQUID PARTITION OF THEIR THIOCYANATES. **Fischer, Werner; Deierling, B.; Heitsch, H.; Otto, G.; Pohlmann, H.-P.; Reinhardt, K. (Technische Hochschule, Hanover). Angew. Chem. Int. Ed. Engl., 5: 15-23(Jan. 1966).**

The partition equilibria of zirconium and hafnium thiocyanates between water and methyl isobutyl ketone were studied under various conditions. Since the system showed extremely marked deviations from Nernst's distribution law, the two elements cannot be prepared in a very pure state by a simple multi-stage partition. By the use of suitable additives and a new scheme of material flow, however, a continuous process using 23 mixer settlers was developed, by means of which ZrO_2 containing less than 10 ppm of HfO_2 and HfO_2 containing only 0.3% of ZrO_2 can be obtained from a zirconium–hafnium mixture (hafnium content: 1 to 2%). (auth)

18829 SOLVENT EXTRACTION STUDIES OF THE AMINE NITRATE COMPLEXES OF THORIUM, URANIUM, AND CERIUM. **Alian, A.; Souka, N. (Atomic Energy Establishment, Inshas, United Arab Republic). Atompraxis, 12: 87-90(Feb. 1966).**

The partition of thorium between nitric acid solutions and solutions of tertiary amines in inert diluents was investigated. The decrease in the extraction coefficient at high acidities was interpreted to be due to the formation of an amine dinitrate, which does not interact with thorium nitrate. The extraction of thorium in presence of different cations and anions was also investigated. On basis of extraction data the thermodynamic formation constants of thorium were evaluated. The activity coefficients of thorium nitrate were also estimated at different nitric acid concentrations. Thermodynamic formation constants and activity coefficients were similarly determined for both uranium and cerium using previous data. (auth)

18830 SEPARATION OF ^{99m}Tc FROM IRRADIATED MOLYBDENUM. **El-Garhy, M.; Moustafa, Z.; Mikheev, N. B. (Atomic Energy Establishment, Inshas, United Arab Republic). Atompraxis, 12: 93-5(Feb. 1966).**

The absorption of phosphomolybdate on active charcoal was investigated. The capacity of coal with regard to phosphomolybdate was found to be 1 g MoO_3 per 1 g coal. This method was used for the separation of ^{99m}Tc from irradiated molybdenum. The yield of ^{99m}Tc was equal to 50 to 70% and its radioactive purity was 95%. The radioactive purity of ^{99m}Tc was increased to 99.5% on the basis of isotopic exchange between radioactive molybdenum and inactive phosphomolybdate or by absorption of radioactive molybdenum on an aluminum oxide column. Absorbed phosphomolybdate on charcoal can be used as a technetium generator. (auth)

18831 STUDIES OF SCANDIUM IN VARIOUS SOLUTIONS. I. AN ION-EXCHANGE STUDY OF SCANDIUM(III) CHLORIDE AND NITRATE COMPLEXES. **Sekine, Tatsuya; Hasegawa, Yuko (Tokyo Coll. of Science). Bull. Chem. Soc. Jap., 39: 240-3(Feb. 1966).**

The complex formation of scandium(III) with chloride and nitrate ions was investigated at 25°C. ^{46}Sc was employed in conjunction with a cation-exchange resin (Dowex 50W X-12, 100 to 200 mesh) in the H^+-form and the ionic strength was maintained at 4.0M with perchloric acid. The stability constants were obtained graphically by a curve-fitting method. (auth)

18832 STUDIES OF SCANDIUM IN VARIOUS SOLUTIONS. II. THE EXTRACTION OF SCANDIUM(III) WITH TRIBUTYL PHOSPHATE FROM PERCHLORATE–CHLORIDE AND PERCHLORATE–NITRATE MEDIA. **Sekine, Tatsuya; Hamada, Takeshi; Sakairi, Mitsuo (Tokyo Coll. of Science). Bull. Chem. Soc. Jap., 39: 244-6(Feb. 1966).**

The distribution of scandium(III) between organic tributyl phosphate solutions and aqueous perchlorate, nitrate, chloride solutions, or mixed solutions of perchlorate–nitrate, perchlorate–chloride was determined. The distribution of scandium between 50% tributyl phosphate–chloroform and 4M H(Cl, ClO_4) or 4M H(NO_3, ClO_4) in some chloride or nitrate concentration region was higher than the distribution between the organic phase and 4M perchloric acid, 4M hydrochloric acid, or 4M nitric acid. It seemed that the enhancement of the distribution ratios could be attributed to the extraction of mixed ligand complexes, but no simple relation was established between the distribution ratios and the proportion of the complex species in the aqueous phase as calculated from the previous data. (auth)

18833 SEPARATION OF ^{95}Zr AND ^{95}Nb BY SOLVENT EXTRACTION USING TRIFLUOROACETYLACETONE AND BENZOYLTRIFLUOROACETONE. **Shigematsu, Tsunenobu; Tabushi, Masayuki; Matsui, Masakazu. Bull. Inst. Chem. Res., Kyoto Univ., 43: 339-46(Sept. 1965).**

The separation of ^{95}Zr and ^{95}Nb by the solvent extraction was studied using trifluoroacetylacetone or benzoyltrifluoroacetone as a chelating reagent. Zirconium is almost completely extracted with benzene from 0.1 to 0.5N H_2SO_4 solution containing 0.1% H_2O_2 and 0.5M trifluoroacetylacetone, or with 0.1M benzoyltrifluoroacetone–benzene from 0.3 to 0.5N H_2SO_4 solution containing 0.1% H_2O_2, whereas Nb remains in aqueous layer, showing DF values of 5×10^2 to 2×10^3 or 1 to 1.5×10^2, respectively. These procedures have the advantages that pH control is not needed and salt-free ^{95}Nb tracer can be obtained as well as ^{95}Zr tracer. The procedure using trifluoroacetylacetone is considered very useful, because the extraction equilibrium is rapidly attained, Zr is readily stripped into 4N H_2SO_4 solution, and the reagent is easily decomposed by fuming with H_2SO_4. (auth)

18834 OXIDIZING ALKALINE MELT AS DECOMPOSITION AGENT FOR IRRADIATED FUEL MATERIALS. **Baehr, W. (Kernforschungszentrum, Karlsruhe, Ger.). Chem.-Ing.-Tech., 38: 145-50(Feb. 1966). (In German).**

The chemical processing of irradiated nuclear fuels containing molybdenum, niobium, and the like by means of the decomposition process is difficult because of the resulting voluminous hydroxide precipitates. However, molybdenum can be converted to an alkaline molybdate by an oxidizing, alkaline melt decomposition process, e.g., with $NaNO_3$, $NaNO_3$/NaOH, $NaNO_3$/Na_2CO_3, while the fuel itself is formed as a crystalline, readily filtrable precipitate containing only very small amounts (<1%) of molybdenum. The losses of fuel and iodine are much lower with the melt process than with the acid method, and the radioactive by-products can be easily separated. (auth)

18835 BARIUM SULFATE ACTIVATED FOR SORPTION OF STRONTIUM BY HEAT TREATMENT WITH CALCIUM SULFATE. **Berak, L.; Muenich, J. (Inst. of Nuclear Research, Rez, Czechoslovakia). Collect. Czech. Chem. Commun., 31: 881-901(Feb. 1966).**

By heat treatment of barium sulfate with calcium sulfate a selective sorbent was obtained for ions whose sulfates are isomorphous with barium sulfate. The conditions of the preparation of the most suitable sorbent were investigated and the capture of strontium from solutions containing soluble calcium salts was studied. The reaction mechanism is explained in first approximation. (auth)

18836 MOBILE INSTALLATION FOR EXTRACTION WITH AMINES. **Regife, J. M.; Cordero, G. Energ. Nucl. (Madrid), 9: 410-18(Nov.-Dec. 1965). (In Spanish).**

A pilot plant for uranium recovery using amine extraction with a treatment capacity of $2 m^3$/hr is described. The major part of the equipment is characterized by its mobility in order to couple the pilot plant to field installations to recover the uranium from solutions from the leaching procedures. The equipment is described and it consists basically of two batteries of compartments, one for extraction

and the other for re-extraction. Results of counter-current laboratory tests on conventional or statistical leaching solutions are presented. (tr-auth)

18837 PARTITION CHROMATOGRAPHY OF THE RARE EARTHS WITH Di-(2-ETHYLHEXYL)-PHOSPHORIC ACID. PART V: PRODUCTION OF RADIOCHEMICALLY PURE GADOLINIUM AND DYSPROSIUM OXIDES. Grosse-Ruyken, H.; Bosholm, J.; Reinhardt, G. (Technische Univ., Dresden). Isotopenpraxis, 1: 124-5(Dec. 1965). (In German).

Impurities of adjacent rare earths were separated from tenths of grams of ^{203}Gd and ^{202}Dy by partition chromatography with bis(2-ethylhexyl) phosphate in such a manner that they could no longer be detected by activation analysis, corresponding to a residual content of less than 10^{-10}% of Eu and 10^{-7}% of Tb for the given conditions of activation. (auth)

18838 GAMMA RAYS AND DELAYED NEUTRONS FROM ANTIMONY AND ARSENIC ISOTOPES. Tomlinson, L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem., 28: 287-301(Feb. 1966).

A technique is described for the rapid separation of antimony and arsenic isotopes from other fission products, based on the formation of antimony and arsenic hydrides in a nuclear reactor. The major peaks in the gamma spectra of ^{128}Sb (9 min), ^{129}Sb (4.5 hr), and ^{130}Sb (39 min) are reported and compared with other recent measurements. Delayed neutron emission was observed from antimony and arsenic isotopes. The experimental evidence indicated that there are three delayed neutron precursors; two of these have half lives of 2 sec and are tentatively assigned to ^{135}Sb and one of the isotopes $^{85-87}$As; the third, and as yet unassigned, precursor has a half life of 14 ± 4 sec. The existence of a 6-sec delayed neutron precursor, which is a daughter product of one of the rare gases, was confirmed. (auth)

18839 EXTRACTION OF URANIUM(IV) NITRATE BY TRIDECYLMETHYLAMMONIUM NITRATE. Koch, G.; Schwind, E. (Kernforschungszentrum, Karlsruhe, Ger.). J. Inorg. Nucl. Chem., 28: 571-5(Feb. 1966). (In German).

Quadrivalent uranium is extremely well extracted, from aqueous nitric acid, by solutions of tridecylmethylammonium nitrate in organic solvents. The distribution coefficient is maximum at about 2 to 3M HNO_3. The extracted complex was isolated and identified as tridecylmethylammonium hexanitratouranate (IV), $[R_3(CH_3)N]_2[U(NO_3)_6]$. Futhermore, spectroscopic evidence showed that uranium (IV) is extracted as the $[U(NO_3)_6]^{2-}$ anion. From the infrared spectrum it was concluded that the nitrate in this complex is co-ordinatively bound to uranium, and that bonding in the uranium (IV) compound is similar to that in the analogous thorium complex. (auth)

18840 CATION-EXCHANGE PROPERTIES OF ZIRCONYL OXALATE PRECIPITATES. Medeiros, L. O. (Laboratorio de Fisica e Engenharia Nucleaires, Sacavem, Portugal). J. Inorg. Nucl. Chem., 28: 599-606(Feb. 1966).

Gel-like and crystalline "zirconyl oxalate" cation exchangers were precipitated from zirconyl chloride and ammonium oxalate solutions, and their composition, pH titration behavior and selectivity towards the alkali cations were studied. The results suggested that these precipitates could be represented by the formula $ZrO(OH)C_2O_4H$. The exchangers were found to release oxalate readily on titration with NaOH. In acid media the zirconium: oxalate mole ratio did not seem to be substantially affected, although the selectivity was altered. The order of increasing affinity of the NH_4-form gel-like exchangers for the alkali cations was Na < K = Rb = Cs. The crystalline precipitate was more selective and exhibited the affinity sequence Na < Cs < Rb < K. (auth)

18841 STOICHIOMETRY OF ION EXCHANGE MATERIALS CONTAINING ZIRCONIUM AND PHOSPHATE. Alberti, G.; Torracca, E.; Conte, A. (CNEN, Rome. Univ., Rome). J. Inorg. Nucl. Chem., 28: 607-13(Feb. 1966).

The empirical formula of anhydrous zirconium phosphate materials with P/Zr = 2 is of the type $Zr(HPO_4)_2$. A range of materials was examined with P/Zr < 2, and the results are discussed. Empirical formulas were deduced from weight loss and determinations of pyrophosphate content at various temperatures. The decrease in maximum ion exchange capacity of zirconium phosphate samples dried at different temperatures was derived from determinations of the extent of condensation of POH groups. (auth)

18842 SEPARATION OF CESIUM AND STRONTIUM BY ELECTRODIALYSIS. Hershey, H. C.; Mitchell, R. D.; Webb, W. H. (Univ. of Missouri, Rolla). J. Inorg. Nucl. Chem., 28: 645-9(Feb. 1966).

Electrodialysis methods employing Permutit anion exchange membranes (3148) and cation exchange membranes (3142) were investigated for the separation of strontium from cesium. The methods were based on the formation of strontium chelate complexes with EDTA and DTPA. Separations of radiostrontium and radiocesium in equilibrium with their daughter decay products were made with two-cell and three-cell electrodialysers. The best results were obtained with EDTA at an initial pH of 11.0 employing anion exchange membranes. Data suggest that this method is feasible for the separation and purification of radioactive cesium and strontium. (auth)

18843 RADIOCHEMICAL SEPARATION OF TECHNETIUM FROM SPALLATION PRODUCTS: COPRECIPITATION OF Tc(VII) IONS WITH TETRAPHENYLARSONIUM PERRHENATE. Qaim, S. M. (Univ. of Birmingham, Eng. Univ. of Liverpool). J. Inorg. Nucl. Chem., 28: 666-8(Feb. 1966).

A rapid radiochemical procedure, based on the property of coprecipitation of Tc(VIII) ions with tetraphenylarsonium perrhenate, for separating technetium from all the radioactive products formed in the spallation of molybdenum with high-energy protons is described. A tracer study of the coprecipitation was carried out. The radiochemical purity, the decontamination factor, and the chemical yield are discussed. (F.J.H.)

18844 EXTRACTION IN THE SYSTEM: URANYL NITRATE–NITRIC ACID–TRIBUTYL PHOSPHATE-DILUENT. Apelblat, A.; Faraggi, M. (Israel Atomic Energy Commission, Tel-Aviv). J. Nucl. Energy: Pt. A and B, 20: 55-65(Jan. 1966).

Equilibrium relations in the system: uranyl nitrate–nitric acid in 40% v/v TBP/dodecane were studied and the results obtained were transferred to the 20–40% v/v range of TBP concentrations. A method for the computation of steady-state distribution of uranyl nitrate and nitric acid in a set of mixer-settlers is proposed. (auth)

18845 THE EFFECT OF HYDROGEN BOND FORMATION BETWEEN TRI-n-BUTYL PHOSPHATE AND CARBOXYLIC ACID ON URANIUM DISTRIBUTION. Ishihara, Takehiko; Ohwada, Ken (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol., 3: 67-71(Feb. 1966).

The distribution ratio of uranium between tri-n-butyl phosphate and water decreased with the addition of water-insoluble carboxylic acids such as benzoic, lauric, oleic, and stearic acids at various concentrations of nitric acid. It is suggested that the decrease of uranium distribution ratio may be due to hydrogen bond formation between tri-n-butyl phosphate and carboxylic acid. It was indicated from infrared spectrometry that a strong hydrogen bond is formed between tri-n-butyl phosphate and carboxylic acid. In other cases, water-soluble carboxylic acids such as acetic, adipic, and oxalic acids had no effect at all on the distribution ratio of uranium at various concentrations of nitric acid. (auth)

18846 ADHESION OF RADIOACTIVE IONS ON GLASS SURFACES. Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Kerntechnik, 8: 74-8(Feb. 1966). (In German).

The adhesion of radioactive ions on normal glass surfaces was investigated as a function of the pretreatment of the glass, the type of labeled solution used, the concentration of the solution, and the post-treatment of the glass.

The glass was washed with water and dried or stored in chromosulfuric acid, concentrated nitric acid, or in 2N caustic lye. The solutions used were K_2CO_3, $Th(NO_3)_4$, $UO_2(NO_3)_2$, $AgNO_3$, $Sr(NO_3)_2$, $BaCl_2$, $Ba(NO_3)_2$, $Pb(NO_3)_2$, and $Fe(NO_3)_3$. The activity of the glass was measured before and after treatment that was the same as the preliminary processing. The results obtained are shown graphically and in tabular form. The significance of these results is discussed. (J.S.R.)

18847 RADIOCOLLOIDS IN SORPTION SYSTEMS. III. THE EFFECT OF THE HYDROGEN ION CONCENTRATION. Egorov, Yu. V.; Lyubimov, A. S.; Khrustalev, B. N. Radiokhimiya, 7: 386-94(1965). (In Russian).

For sorptive heterogeneous microcomponents (association of independent and differently absorbing sorts of particles) in systems with cation sorbents, the isotherm of sorption association, relating the distribution coefficient and the solution pH, was determined. Results obtained were analyzed and gave satisfactory confirmation both of the factors described in the literature and of the examples of data reported on the sorption of radiocolloids of ^{106}Ru-labeled-$RuCl_3$ by activated manganese dioxide. (tr-auth)

18848 SEPARATION OF AMERICIUM AND CURIUM BY THE METHOD OF ANION EXCHANGE USING SOLUTIONS CONTAINING MIXTURES OF METHYL ALCOHOL AND NITRIC ACID AS ELUENT. Bochkarev, V. A.; Voevodin, E. N. Radiokhimiya, 7: 461-5(1965). (In Russian).

The sorption of Am and Cm on the anion exchange resins AV-17 and Dowex 1 × 8 from solutions of methyl alcohol mixtures with nitric acid was investigated. For the resin AV-17, it was established that an increase of the HNO_3 concentration from 0.1 to 1.6M and of CH_3OH from 80 to 95% leads to a significant increase of the distribution coefficient of Am and Cm. The distribution coefficient K_dAm/K_dCm for the methyl alcohol–nitric acid mixture under the given experimental conditions was a maximum (2 to 3), in comparison with distribution coefficients found by others, most frequently with available eluents such as ammonium citrate, lactate, and α-hydroxyisobutyrate. The distribution coefficient K_dAm/K_dCm was altered very little by change of the nitric acid concentration in the interval from 0.1 to 1.6M. The coefficients and distributions of Am and Cm under these conditions were changed more than the order. The distribution can be successfully carried out in low concentrations of (0.1M) HNO_3. (J.S.R.)

18849 A METHOD FOR THE SEPARATION OF ^{95}Zr AND ^{95}Nb BY EXTRACTION OF ZIRCONIUM IN THE FORM OF MIXED COMPLEXES WITH 8-HYDROXYQUINALDOXIME AND CAPROIC ACID. Rudenko, N. P.; Dziomko, V. M.; Kremenskaya, I. N. Radiokhimiya, 7: 492-4(1965). (In Russian).

A method for the separation of ^{95}Zr from the daughter isotope ^{95}Nb by extraction of Zr in the form of mixed complexes with 8-hydroxyquinaldoxime and caproic acid is reported. (tr-auth)

18850 SEPARATION OF RARE EARTH ELEMENTS BY CERTAIN PHOSPHORUS-CONTAINING EXTRACTING AGENTS. Shvedov, V. P.; Orlov, Yu. F. Zh. Prikl. Khim., 38: 1605-6(July 1965). (In Russian).

The effect of the composition of a series of organophosphorus extracting agents on the separation of Ce(III)–Pr and Pr–Nd pairs was studied. The separation factors were determined for extraction from an aqueous phase containing a mixture of the two rare earth elements and a salting-out agent, aluminum nitrate. The mechanism of extraction of cerium, and probably the other elements, may be represented by the reaction $Ce^{3+} + 3NO_{3\,aq}^{-} + 3S_{org} \rightleftharpoons Ce(NO)_3 \cdot 3S_{org}$, where S is a molecule of the extracting agent. Constants for this equilibrium are given; they constitute a measure of the extracting capacity of the agents employed. Changes in the nature of the substituents strongly affected the extracting capacity, but had virtually no effect on the separation factors of the Ce(III)–Pr and Pr–Nd pairs. However, when tricyclohexyl and tri-sec-butyl phosphate were used, a certain decrease in separation factors was observed relative to the other extracting agents. (CFSTI)

ENGINEERING

General

Refer also to abstracts 19109 and 19215.

18851 (N-65-26627) DEVELOPMENT OF ELECTRICAL SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS. Quarterly Progress Report No. 1, December 4, 1964–March 4, 1965. Edwards, R. N. (ed.) (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). Contract NAS3-6467. 54p. (NASA-CR-54401). CFSTI $3.00 cy, $0.50 mn.

The design and development of ground prototype a-c circuit breakers and d-c engine contactors suitable for space environment are continuing. Material for the vacuum interrupter enclosure and contacts, interrupter and actuator design concepts, and facilities for making heat run and endurance tests were selected. Material selection required a solution to outgassing and contact resistance problems. Studies showed that all possible materials would outgas to such an extent that continued scavenging would be necessary. Rodar, thoria dispersed nickel, commercially pure titanium, and arc-cast molybdenum were selected. High contact resistance was encountered during interruption tests on the prototype switch. A single-pole actuator design for both a-c and d-c applications was selected. Studies were initiated to determine vacuum interrupter heat transfer requirements. A vacuum test chamber oven design using quartz lamps as the heat source was selected. (STAR)

18852 (SCL-DR-65-144) DYNAMIC RESPONSE OF A LONG CYLINDRICAL SHELL TO THERMAL LOADING. Robinson, C. W. (Sandia Corp., Livermore, Calif.). Feb. 1966. Contract AT(29-1)-789. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The equations of motion for a long, cylindrical shell are solved for the case of a temperature distribution in the shell which varies independently with angle, time, and depth through the shell. The solutions are obtained by superimposing two approximate solutions. Expressions for the stress and displacements are derived in series form. The appendices contain the information necessary to use the computer program which was written to solve the differential equations. (auth)

18853 (SWRI-1228-8-20) FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS. Quarterly Technical Report No. 6. Burton, R. A.; Hsu, Y. C. (Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research). Mar. 1, 1966. Contract AT(11-1)-1228. 47p. (RS-482). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The calculated performance of finite tilting pad bearings is reported in terms of mean pressure and center-of-pressure location, as functions of length/width ratio, and tilt angle. The performance of a stepped pad is calculated by an iterative numerical program, and the pressure distribution is shown to resemble closely that measured experimentally. Interactions between a shear flow and pressure flows of different directions and magnitudes are investigated by application of the mixing length approach. (auth)

18854 (TID-4100(Suppl.32)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Duthie, Richard E. C. (ed.) (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). Feb. 1966. 78p. Dep. DTI Extension Free.

Supplement insert sheets are presented for 46 numbers assigned to engineering drawings for computers, monitors, nuclear radiation instruments, hot laboratory equipment, nuclear reactors and reactor facilities, plant design and processes, radiation equipment (biological), thermonuclear devices, waste disposal equipment, and other instruments. They should be retained and used with the cumulative contents in Cumulative Index No. 2, (TID-4100, 1st Rev.) August 1962, and in the Cumulative Indexes (TID-4102, 1st Rev.) June 1965. (P.C.H.)

Applications of Nuclear Explosions

18855 (CEA-Bib-66) APPLICATIONS SCIENTIFIQUES DES EXPLOSIONS NUCLEAIRES. 2 EME PARTIE. GEOLOGIE, SEISMOLOGIE ETUDE DES SOLS, FRACTURE DES ROCHES. (Scientific Applications of Nuclear Explosions. Part 2. Geology: Seismology, Soil Studies, Rock Fissuring). Berton, Micheline (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 158p. Dep. mn.

Seven hundred (700) references are given to journals and reports published from 1960–1965. The references are classified into two main groups: first, seismology, then studies concerning the behavior of soils, grounds, and subterranean waters when rocks are cracked during nuclear explosions. An author index is included. (P.C.H.)

18856 EFFECTS OF SHOCK PRESSURES FROM A NUCLEAR EXPLOSION ON MECHANICAL AND OPTICAL PROPERTIES OF GRANODIORITE. Short, Nicholas M. (Univ. of California, Livermore). J. Geophys. Res., 71: 1195-1215(Feb. 15, 1966). (UCRL-7949).

The Hardhat shot, fired February 15, 1962, was a 5.0 ± 1.0 kt nuclear detonation 286 meters underground in granodiorite at the Nevada test site. Postshot exploration included drilling four holes approximately radially into the cavity region. Core samples were examined for variations in microfractures, plastic deformation, and physical properties, i.e., strengths, sonic velocities, permeability, as functions of shock pressures in the 2- to 110-kb region over preshot distances of three cavity radii. Cavity radius was 19 meters. A fracture index, defined as the average fracture frequency per thin section, shows the degree of microfracturing. Fracturing gradually increases from a preshot index of 3.0 to 7.5 over a 36-meter interval subjected to pressures that reached 50 kb at 18 meters from the shot point. Nearer the cavity, the index increases to 16.2 at the 100-kb point. Extension fractures in quartz show preferred orientations close to the cavity but become random farther outward. Quartz grains in granodiorite experiencing peak compressive stresses above 50 kb (estimated) contain two to five sets of parallel planar surfaces per grain. These appear to develop by plastic adjustments in intensely shocked rock. Biotite displays intense kink banding in granodiorite shocked above 30 kb. These petrofabric features allow estimates of pressures and interpretation of transient states of stress during the explosion. (auth)

Facilities and Equipment

Refer also to abstract 20348.

18857 DEVELOPMENT OF A HIGH-TEMPERATURE MOLTEN LITHIUM PUMP. Kelly, R. W.; Wood, G. M.; Milich, J. J.; Ferguson, C.; Manfredi, D. V. (Pratt and Whitney Aircraft, Middletown, Conn.). Contract AT(30-1)-2789. J. Eng. Power, 88: 13-21(Jan. 1966).

The circulation of the liquid-metal heat-transport fluids used in high-performance, mobile, nuclear power plants requires high-temperature pumps. These pumps must be capable of moderately high efficiency over a very long lifetime and have small size, low weight, and high reliability. As an initial phase of a lithium pump development program and to provide pumps for companion development programs, a 195-gpm pump was designed and successfully developed. Extensive testing of pump components, as well as water and liquid-metal tests of complete pump

assemblies, was accomplished to meet the program objectives of high performance and high reliability for the required long operating lifetime. Several successful lithium tests of 10,000-hr duration were accomplished with the lithium development pumps and a pump used in a companion heat-exchanger development program. (auth)

18858 SAMPLE-HOLDING DEVICE, ASSOCIATED WITH AN EXPERIMENTAL HOLE PLUG. Oigami, Hiroshi (to Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1964-3080. Feb. 17, 1965. Filed July 10, 1963.

An improved sample-holding device associated with an experimental hole plug is proposed for easy disconnection of a sample material from the experimental-hole plug. A removable joint is provided between the base of the sample holder with measuring wires and the base of a hollow experimental-hole plug. An annular groove is cut on the outside of this joint. The wires attached to the sample material run through this groove in the direction of the plug axis in the form of a bridge spanning the groove. (NSA of Japan)

Heat Transfer and Fluid Flow

See also PHYSICS — Fluid Physics and Thermodynamics

Refer also to abstracts 20187, 20190, 20236, and 20263.

18859 (AEEW-R-432) METHODS OF DETECTING THE ONSET OF BURN-OUT IN ROD CLUSTERS. Adnams, D. J.; Salt, K. J.; Wintle, C. A. (Atomic Energy Establishment, Winfrith (England)). Dec. 1965. 31p. Dep. BIS $1.10. HMSO 5s.6d.

An experimental investigation was made of the relative performance of various types of detector element for use inside a water cooled test section under typical burnout conditions. The types of detector element include thermopile and resistance elements based on either heat conduction or radiation principles. (auth)

18860 (BNWL-206) EXPERIMENTAL BOILING BURNOUT HEAT FLUXES WITH AN ELECTRICALLY HEATED 19-ROD BUNDLE TEST SECTION. Hesson, G. M.; Fitzsimmons, D. E.; Batch, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1965. Contract AT(45-1)-1830. 47p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A total of 76 boiling burnout experiments was made with an electrically heated model of a 19-rod bundle fuel element. The tests were made under a variety of conditions including two pressures, both rough and smooth wall flow housing, both subcooled and fog (wet steam) inlet coolant, and two inlet piping configurations. The experiments were made at coolant flow rates from 1,000,000 to 3,000,000 lb/hr-ft^2, and with coolant inlet conditions ranging from 300°F subcooled to 40% quality steam. Detailed results are presented. (M.O.W.)

18861 (COO-11 18) COMBINED TURBULENT CONVECTION HEAT TRANSFER TO NEAR CRITICAL WATER. Touba, R. F.; McFadden, P. W. (Purdue Research Foundation, Lafayette, Ind.). Jan. 1966. Contract AT(11-1)-1177. 255p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

The experimental study deals with an investigation of heat transfer to near critical water flowing through a heated vertical tube. Turbulent free and forced convection flow was present. Two AISI type 304 seamless stainless steel tubes of 0.245 and 0.370 inch inside diameter served as joulean heated test sections. The following variables were investigated; test section bulk fluid temperature, pressure, mass flux, heat flux, wall temperature, and wall to bulk fluid temperature differences. Local heat transfer and Stanton numbers were computed from the data. The data were checked against the Dittus-Boelter equation and good agreement was obtained for temperatures below 650°F or Prandtl number, based on the bulk fluid temperature, not exceeding 1.20. The new correlation of Swenson, Carver, and Kakarala was also tested, which proved satisfactory up to a temperature of around 690°F. Beyond that range agreement deteriorated rapidly with proximity to the peak temperature. The peak temperature was defined as the temperature at which the isobaric specific heat curve peaked. The effect upon heat transfer of the proximity of both the wall and/or fluid temperatures to the peak temperature was tested. (M.O.W.)

18862 (COO-1177-19) HIGH FLUX HEAT TRANSFER TO SUB- AND SUPERCRITICAL WATER. Final Report. McFadden, P. W.; Schoenhals, R. J. (Purdue Research Foundation, Lafayette, Ind.). Jan. 1966. Contract AT(11-1)-1177. 23p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

During this period, the following five areas were investigated: (1) single and two-phase heat transfer to near critical water under forced convection in an electrically heated vertical tube, (2) combined turbulent convection heat transfer to near critical water, (3) turbulent free convection in near critical water, (4) free convection flow in circulation loops, and (5) acoustic velocities for high pressure carbon dioxide and water at supercritical temperatures. For the first three areas, additional information on heat transfer to sub- and supercritical water was obtained. For the last two areas, listed results were obtained which relate to fluid flow, flow instabilities, and the dynamic behavior of fluids at high pressures and temperatures. (M.O.W.)

18863 (EURAEC-1360) A THEORETICAL STUDY ON TWO-PHASE FLOW CHARACTERISTICS. van der Walle, F.; Spigt, C. L.; Lamein, H. J.; Bogaardt, M. (Technische Hogeschool, Eindhoven (Netherlands)). Apr. 30, 1965. 18p. (EUR-2335.e; CONF-650670-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Two-Phase Flow, Exeter, Eng.

Work Performed under United States-Euratom Joint Research and Development Program.

A theoretical model describing the heat transfer and fluid flow characteristics in vertical boiling channels is derived from first principles. In general flow equations, that is to say the continuity, momentum, energy equation, and the equation for diffusion and growth of bubbles were formulated for the unsteady case. The theoretical model ascribes the increase in frictional pressure drop and heat transfer in two phase flow as compared to single phase flow to an increased turbulence level due to the relative movement of the vapor bubbles with respect to their surroundings. The formulation of the equations results in a set of simultaneous partial differential equations for the various unknowns as a function of the space and time coordinates. After the introduction of dimensionless parameters it is found that 8 similarity parameters govern the solutions of the exact equations. By the introduction of prescribed radial distribution for the velocity, temperature and bubble density the set of equations was reduced to a set of ordinary differential equations. Results of calculations are given for an annular geometry test section as a function of the conditions at the inlet of the riser section. Comparisons are made with void fraction data obtained in the experimental two phase flow program that is being carried out in this laboratory. (auth)

18864 (GEAP-4935) RADIAL VANE STEAM SEPARATOR DEVELOPMENT: EXPERIMENTAL STUDY OF CARRYUNDER SOURCES IN A RADIAL VANE SEPARATOR. Kudirka, A. A.; Gifford, J. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Nov. 1965. Contract AT(04-3)-189. 53p. (EURAEC-1585). Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Visual and photographic analyses were made of flow separation on a radial vane. To accomplish this task, separation of air-water mixtures was studied experimentally on a clear plastic radial vane of 4-inch radius and 130-degree-arc length. The nozzle introducing the

mixture on the vane was 18 inches long and 1/4 inch wide. Study of flow spread on the vane substantiated previous analysis. Flow on the vane and the jet from the end of the vane were quite stable for all the conditions tested. Velocity and thickness measurements of the water jet at the end of the vane were used to determine slip ratios in the nozzle and to help in calculating carryunder from the vane. Bubble size distributions shifted continuously toward smaller bubble sizes as nozzle velocity was increased, and the average bubble diameters were approximately inversely proportional to nozzle velocity. Bubble size distributions were quite similar for each run at the entrance and exit of flow on the vane. Amounts of air that did not separate on the vane were calculated from bubble counts of photographs. Only about 1 percent by volume of air input did not separate in the range from 10 to 15 percent steam quality. Carryunder from the vane, calculated in terms of equivalent steam carryunder by weight, was generally well within the 0.2 percent limit used in reactor design. Since indications are that steam bubbles can be expected to separate at least as readily as air bubbles, separation of steam on the vanes should be complete enough to satisfy the design requirements quite readily. (auth)

18865 (LA-3418) LONGITUDINAL LAMINAR FLOW OF AN INCOMPRESSIBLE FLUID IN FINITE TUBE BUNDLES WITH M + 1 TUBES. Axford, Roy A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 11, 1965. Contract W-7405-eng-36. 85p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The axial component of the laminar flow velocity field of an incompressible, Newtonian fluid in longitudinal flow in a finite tube bundle containing m + 1 tubes in a cylindrical channel is determined by the method of harmonic functions. FORTRAN listings of the main source program together with its three subprograms are given. (auth)

18866 (LA-3425) THE MAC METHOD—A COMPUTING TECHNIQUE FOR SOLVING VISCOUS, INCOMPRESSIBLE, TRANSIENT FLUID-FLOW PROBLEMS INVOLVING FREE SURFACES. Welch, J. Eddie; Harlow, Francis H.; Shannon, John P.; Daly, Bart J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 1965. Contract W-7405-eng-36. 144p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

A detailed description is presented of the Marker-And-Cell (MAC) technique developed at Los Alamos for solving fluid flow problems. The method is appropriate for use with a high-speed digital computer. The fluid is incompressible, viscous, and moves through large-amplitude contortions in several space dimensions. There may be a free surface upon which waves can form and break, or the flow may be entirely confined by walls. Development of the fluid configuration can be investigated through as much elapsed time as desired. The motions are calculated by using the complete Navier-Stokes equations, including all nonlinear terms. The only approximations arise from the finite-difference representation. Pressure and velocity are used directly as the dependent variables; neither stream function nor vorticity enters except as results derived from the velocity field. The basic method, its theoretical properties, and some extensions are described. A detailed description of the logic of the present code is presented. Numerous calculational examples are given to show the wide scope of applicability. The extension of the method to computations involving two fluids is described. (auth)

18867 (NP-15897) THERMAL CONTACT CONDUCTANCE IN A VACUUM. Yovanovich, M. Michael (Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.). Nov. 1965. Contract NGR 22-009-065. 132p. (DSR-4542-39).

Equations were developed by which one could predict the thermal contact conductance between contiguous surfaces operating in a vacuum environment. The solution to the problem was obtained by considering that any surface can be modelled as being either; nominally-flat but rough, a smooth surface having cylindrical waviness, a smooth surface having spherical waviness, or a surface having either cylindrical or spherical waviness plus roughness. Since the radiative heat transfer and the conduction through the interstitial fluid are negligible, the conduction of heat across the metal contact spots is the dominant mechanism. It is considered that the prediction of thermal contact conductance must be approached by: examining the surface geometry, proposing mathematical models for the solution of the heat transfer problem, determining the surface parameters from deformation analysis, and obtaining experimental data to substantiate the proposed models. The thermal analysis is based upon the models proposed and the solutions for the steady-state condition are obtained for the various models and the appropriate boundary conditions. Certain surface parameters appear in the thermal contact conductance equations, which require that an analysis of the deformation of the surface under load be undertaken. The deformation analysis is separated into two regimes: purely elastic and purely plastic. The surface parameters are then determined as functions of the applied load for the proposed models under the restrictions of pure elastic or pure plastic deformation. (auth)

18868 (NYO-2930-5) THE MOTION OF SMALL PARTICLES IN NON-UNIFORM TEMPERATURE FIELDS [Thesis]. Technical Report No. 107-ME-F. Dwyer, H. A. (Rutgers-The State Univ. of New Jersey, New Brunswick. Bureau of Engineering Research). Feb. 1966. Contract AT(30-1)-2930. 90p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A study of the effects of temperature gradients on the motion of small particles in both gases and liquids was undertaken to obtain the equations needed to determine the thermal forces. It is shown that the particle in a gas and the particle in a liquid problem are fundamentally different, and that nonrelated methods had to be used to obtain solutions. A system of equations covering the entire range of Knudsen numbers was developed to explain the thermal force experienced by a particle in a gas. For a particle in a nonuniform temperature liquid the Brownian motion solution of Chandrasekhar was extended to include the effects of the nonuniform temperature. A linearized version of Grad's Thirteen Moment equations was solved with generalized velocity slip and temperature jump boundary conditions to obtain a theory of the thermal force on a spherical particle in a gas. The theory is in good general agreement with all experimental data over the entire range of Knudsen number variation, and gives the correct dependence on the thermal conductivity of the particle. For a large Knudsen number (transition regime) the solution is functionally the same as L. Waldmann's and in the free molecular regime it agrees with Knudsen's experimental results. As a by-product of the theory, thermal accommodation coefficients can be predicted with fair to good accuracy. For particles with high thermal conductivities and high accommodation coefficients the theory also predicts the possibility of a reversal of the thermal force in the near continuum limit. This reversal of thermal force is a result of normal stresses on the particle caused by normal heat transfer. The motion of a particle in a nonuniform temperature liquid was solved by modifying Chandrasekhar's Brownian motion solution. The solution to the nonuniform temperature problem was obtained in terms of a Gaussian distribution with a time and space dependent standard deviation for both velocity and position. From this Gaussian probability distribution the root mean square dispersion can be found, since by definition it is the same as the standard deviation. For a linear variation in the liquids temperature the Brownian particle root mean square dispersion was found to be constant in time, and no Brownian particle mean thermal motion was predicted. It seems from the analysis that in order to have a Brownian particle mean thermal motion a nonsymmetric transition probability for the random thermal force would have to be introduced. In the case of a quadratic temperature field the Brownian particle root mean square dispersion increased or decreased, respectively, as the Brownian particle moved from its initial position. Again, no Brownian particle mean

thermal motion was predicted. Time dependent temperature field Brownian particle solutions were obtained for an arbitrary temperature variation. (auth)

18869 (NYO–3114-10) TWO-PHASE FLOW AND BOILING HEAT TRANSFER. Interim Report: CO-CURRENT UPWARDS ANNULAR-MIST FLOW. Meyer, P. E.; Wallis, G. B. (Thayer School of Engineering, Dartmouth Coll., Hanover, N. H.). Sept. 1965. Contract AT(30-1)-3114. 124p. (EURAEC–1480). Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

An investigation of co-current upwards annular-mist flow was conducted with fluid combinations of air/water, air/heptane, argon/ethyl alcohol, and steam/water at various pressures. Frictional pressure drop data were tested against homogeneous and separated flow models. Homogeneous flow theory with a homogeneous friction factor of .02 correlated the data within the expected accuracy of the data. (auth)

18870 (SAN–409–28) HIGH ACCELERATION FIELD HEAT TRANSFER FOR AUXILIARY SPACE NUCLEAR POWER SYSTEMS. Annual Technical Report, September 1, 1964–August 31, 1965. Poppendiek, H. F.; Greene, N. D.; Sabin, C. M.; Feigenbutz, L. V.; Mouritzen, G.; Schwartz, P. E.; Connelly, D. J.; Morton, W. A. (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-409. 123p. (GLR–41). Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Heat transfer and momentum transfer by boiling liquid metals were investigated experimentally and theoretically. High-acceleration-field boiling and helical-flow phase separation were emphasized. Potassium was used as the working fluid in the experiments. (D.C.W.)

18871 (STL–372-14(1)) HYDRODYNAMIC STABILITY OF NATURAL CIRCULATION BOILING SYSTEMS. VOLUME I. A COMPARATIVE STUDY OF ANALYTICAL MODELS AND EXPERIMENTAL DATA. Neal, L. G.; Zivi, S. M. (TRW Systems, Redondo Beach, Calif.). June 30, 1965. Contract AT(04-3)-372. 190p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

This study of hydrodynamic instability is presented in three parts. First, the mechanisms of instability considered by a number of authors are discussed, and the experimentally observed effects of various system parameters are summarized. Then, the basic conservation equations are derived in general form, and each model is described relative to these equations. Differences and similarities in the models are shown. Finally, the predictions of each model are compared with experimental data, and the relative predicting power of each model is evaluated. (M.O.W.)

18872 (STL–372-27, pp 13-21) HIGH-PRESSURE LOOP FOR STUDIES OF SUBCOOLED BOILING. Neal, L. G. (TRW Systems, Redondo Beach, Calif. Applied Thermodynamics Dept.).

A description of the high pressure loop designed for studying subcooled boiling void response to reactor power modulation is given. (M.O.W.)

18873 (UCB–34P64-1) DYNAMIC RESPONSE OF A DUAL-HEAT-EXCHANGER SYSTEM. Final Report. Takahashi, Y.; Thal-Larsen, H. (California Univ., Berkeley). May 1965. Contract AT(11-1)-34. 188p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Research work on different aspects of the dynamic behavior of a dual-heat-exchanger system is presented in six separate sections. In (1) the temperature interaction between a flowing fluid and the confining metal pipe is investigated. In (2) the research is directed at learning how oscillatory fluid-temperature transients are produced. (3) It is shown that the centerline velocity of the fluid has an appreciable effect on fluid-temperature transients. (4) A theoretical analysis is made of the dual heat exchanger on the basis of a linear stationary distributed-parameter system. The formulation of the system on the basis of a lumped approximation is undertaken in (5), as this allows the theoretical analysis to be expressed in the context of a state vector. Finally, in (6), an attempt is made to unravel the problems associated with optimal control. (M.O.W.)

18874 PHASE VELOCITIES IN BOILING FLOW SYSTEMS BY TOTAL ENERGY AND BY DIFFUSION. Polomik, E. E. (General Electric Co., San Jose, Calif.). J. Heat Transfer, 88: 10-18(Feb. 1966).

A total energy balance is employed in a single-component boiling flow system to obtain minimum limiting values of vapor volume content and show the effects of phase velocity distributions. Results are compared to data of various investigators in steam-water systems at pressures of 115 to 1000 psia. Limiting equations are used for derivation of more accurate relations. A correlating function and equation are derived, from the generalized diffusion velocity for momentum, which relate voids, quality, and kw/liter. These are used to correlate Argonne's steam voids data in a boiling channel at 163 and 614 psia with velocities in the range 1.83 to 5.94 ft/sec and steam qualities between 0.008 and 0.07. A simple, semitheoretical relation between quality, vapor fraction, and energy addition/unit boiling volume is obtained which correlates all of the 163 psia data within about 5 percent, and a limited amount of data for 614 psia equally well. (auth)

18875 HEAT TRANSFER AND FLOW CHARACTERISTICS OF POROUS MATRICES WITH RADIATION AS A HEAT SOURCE. Chiou, J. P.; El-Wakil, M. M. (Univ. of Wisconsin, Madison). J. Heat Transfer, 88: 69-76 (Feb. 1966).

A theoretical and experimental study of the heat transfer and flow friction characteristics of matrices of high porosity, with incident radiation from one side resulting in an exponential heat source, and with air as a coolant, is reported. In the theory, a transient solution of simultaneous convection and radiation heat transfer equations was worked out. Used with experimental data taken in the unsteady state, it resulted in calculation of volumetric heat transfer coefficients by convection in the matrices. Correlations with Reynolds numbers based on a characteristic length obtained by equating pressure drops to the sum of viscous and inertia resistance terms, were obtained. Using the more familiar hydraulic radius did not result in reducing the relations to a unified form. The matrices used in the experiments were formed from slit-and-expanded aluminum foils, blackened to high radiant absorptivity. The results of the investigation are believed useful in many solar, nuclear, and space applications. (auth)

18876 HEAT TRANSFER IN PARALLEL ROD ARRAYS. Sutherland, W. A. (General Electric Co., San Jose, Calif.); Kays, W. M. Contract AT(04-3)-189. J. Heat Transfer, 88: 117-24(Feb. 1966).

The general problem of turbulent flow heat transfer in parallel rod arrays is considered. To accommodate the complexity introduced by this configuration, a method of analysis is developed using the technique of superposition of fundamental solutions. Fundamental solutions are determined experimentally which may be used to predict heat transfer in parallel rod arrays of various spacings and with arbitrary power distribution from rod to rod and around the periphery of the rods. The experimental investigation was conducted with airflow (Pr = 0.70) past electrically heated rods. Rod center-to-center spacing to rod diameter ratios of 1.15 and 1.25 were investigated for fully developed turbulent flow. Experimentally determined fundamental solutions are presented for Reynolds numbers from 7000 to 200,000. (auth)

18877 SIMPLE COOLING SYSTEM WITH CIRCULATING HELIUM GAS. Pfeiffer, L.; Keaton, P. W. Jr. (Johns Hopkins Univ., Baltimore). Nucl. Instrum. Methods, 40: 357-8(Mar. 1966).

A system is described in which cold helium gas is forced through a heat exchanger in thermal contact with a sample that is to be cooled to approximately 15°K or higher. The system involves continuous transfer of liquid helium from the storage dewar to the heat exchanger, which is stationary inside a scattering chamber for a 3 Mev Van de Graaff ac-

celerator. Measurements were made with copper constantan thermocouples for a thermal load of a 1 mil copper backing foil onto which a nuclear stopping foil of solid xenon was condensed. (L.B.S.)

18878 EXPERIMENTAL DETERMINATION OF PLANT DYNAMICS BY MEANS OF STATISTICAL METHODS. Cimorelli, L.; Di Bartolomeo, M.; Mathis, A. (CNEN-CSN, Casaccia, Italy). Riv. Ing. Nucl., 3: 731-41(Jan.-Apr. 1965). (In Italian).

The theoretical bases of dynamic analysis by statistical methods are presented and the methods and apparatus needed to perform such an analysis are described. The statistical methods described were applied to the dynamic study of an experimental water circuit in operation at Casaccia. Preliminary results are reported. (J.S.R.)

Materials Testing

18879 (AWRE-O-21/66) A SYSTEM FOR DRIVING A METAL PLATE AT 1000 m/s. Price, J. H.; Yates, J. K. (Atomic Weapons Research Establishment, Aldermaston (England)). Feb. 1966. 11p. Dep. mn. BIS $0.50. HMSO 2s. 6d.

Previously, experiments were described which involved driving a flat metal plate face-on at speeds of about 1000 m/s. Design principles, details of construction, and the setting-up procedure for the particular system used are included. (M.O.W.)

18880 (Y-KD-5) STRAIN GAGE TECHNIQUES AND ASSOCIATED TESTS ON PRESSURE VESSELS AND MATERIALS. Long, P. J. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Mar. 15, 1966. Contract W-7405-eng-26. 29p. (CONF-651141-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Symposium on Nondestructive Testing, Los Alamos, N. Mex.

The use of strain gages to determine the stress distributions over pressure-vessel surfaces, to evaluate welded repairs on high-carbon-steel material in a gas storage vessel, and to determine the dynamic properties of materials that are subjected to high strain rates is discussed. Techniques for the application of strain gages to threaded regions are described. (D.C.W.)

Space Propulsion

See also ISOTOPE TECHNOLOGY — Power Application
REACTOR TECHNOLOGY — Propulsion and Space

18881 (N-65-16742) TWO-STAGE POTASSIUM TEST TURBINE. Quarterly Progress Report No. 13, May 8–August 8, 1964. Schnetzer, E. (ed.) (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). [1964]. Contract NAS5-1143. 142p. (NASA-CR-54211). CFSTI $4.00 cy, $1.00 mn.

A two-stage test turbine being developed for operation in saturated potassium vapor at 1600°F underwent its first potassium vapor test. The performance data are presented and discussed. Evaluation of the converging-diverging potassium nozzle data continued. Average values of inlet to local polytropic exponent were compared at various values of inlet temperature and initial vapor quality. Efforts were continued to identify and eliminate the oil leakage problems. This was successfully accomplished by minor changes in component design and improvement of static seals. In operating the turbine on potassium vapor, turbine inlet temperatures in excess of 1450°F were reached; and the turbine was operated for approximately 4 hr. Materials support involved testing of sealing ring configurations; testing the potassium resistance of the fluorinated hydrocarbon sealing material, Viton; stress-to-rupture tests performed on U-700 material which was exposed to both precipitation heat treatment and to the A-286 heat treatment; investigation of oil contamination of the potassium in the main potassium loop of the turbine facility; boiler exhaust potassium detection; and turbine materials rub testing. (STAR)

18882 (N-65-16890) AN EXPERIMENTAL INVESTIGATION OF PEAK AND AVERAGE HEATING EFFECTS IN CASCADE-ARC JET. Beasley, W. D.; Barger, R. L.; Brooks, J. D. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Feb. 1965. 22p. (NASA-TN-D-2653). CFSTI $1.00 cy, $0.50 mn.

The results of a systematic investigation of some gas-heating characteristics of a supersonic arc jet are presented. The gas-heating mechanism was a constricted arc in the throat of a cascade nozzle arrangement. The effects of varying the arc current, pressure, and flow medium on the ejection velocity and settling-chamber pressure rise were measured. To the extent that the ejection velocity can be related to the peak throat temperature, and the settling-chamber pressure to the average throat temperature, the results are consistent with experimental and analytical studies of stationary arcs. (STAR)

18883 (N-65-21432) AN EXPERIMENTAL MODEL OF A 2-Kw, 2500-VOLT POWER CONVERTER FOR ION THRUSTORS USING SILICON TRANSISTORS IN A PULSE-WIDTH-MODULATED BRIDGE INVERTER. Summary Report. Ernsberger, G. W. (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). Mar. 1, 1965. Contract NAS3-5918. 72p. (NASA-CR-54217; WAED-65-12E). CFSTI $3.00 cy, $0.75 mn.

Two power supply models were built and evaluated. The test program demonstrated that using silicon power transistors in a pulse-width modulated bridge inverter with current-feedback base drive is an effective and desirable method of building a reliable, lightweight, and efficient power converter for ion thrustors. (STAR)

18884 (N-65-22975) INVESTIGATION, TESTING, AND DEVELOPMENT OF AN ELECTRON-BOMBARDMENT ION ENGINE SYSTEM. Final Report, March 3–December 14, 1964. Eckert, A. C.; Coerdt, R. J.; Moffett, M. B.; Mueller, M. W. (Thompson Ramo Wooldridge Inc., Cleveland, Ohio. New Product Research Dept.). Dec. 15, 1964. Contract NAS3-5745. 132p. (NASA-CR-54148; TRW-ER-6291). CFSTI $4.00 cy, $1.00 mn.

An applied research program of investigation, testing, and development of an electron-bombardment, mercury-fueled ion engine system is reported. Ion source performance data are presented for a wide range of conditions of operation, employing electromagnets and a laboratory feed system. Supplementary efforts to develop long-life, efficient, porous-nickel-matrix cathodes are described. Extended tests of over 500 hr on ion engine systems utilizing permanent magnets are reported, and system lifetime estimates based thereon are presented. The associated facility for automatic engine testing is described in detail. (STAR)

18885 (N-65-23253) SPACE ENVIRONMENT FACILITY FOR ELECTRIC PROPULSION SYSTEMS RESEARCH. Finke, Robert C.; Holmes, Arthur D.; Keller, Thomas A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). May 1965. 39p. (NASA-TN-D-2774). CFSTI $2.00 cy, $0.50 mn.

A facility containing 15- and 25-ft-diameter space-environment tanks and support equipment is described. The facility is designed for testing ion and plasma thrustors, spacecraft, and related components at pressures in the 10^{-7} torr range. The pumping systems and 28,000-ft^2 liquid-nitrogen-cooled condenser are described. Data are presented on an auxiliary fast pumpdown tank that simulates ambient pressures encountered during a booster launch to 10^{-6} torr range in approximately 2 min. Pertinent information concerning a spin test apparatus and thrustor installation method is also included. An electrical and instrumentation system is described consisting of 2 Mw of 20-kv d-c power, a 2000-cable patch board network, a 600-channel thermocouple system, and a 400-channel digital data recorder. An annunciator

system is provided to indicate status of operating equipment. Some aspects of safety are considered, including interlocking, personnel protection, and procedures. (STAR)

18886 (N-65-25549) PRELIMINARY OPERATION OF OXIDE-COATED BRUSH CATHODES IN ELECTRON-BOMBARDMENT ION THRUSTORS. Kerslake, William R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). June 1965. 13p. (NASA-TM-X-1105). CFSTI $1.00 cy, $0.50 mn.

Initial experimental results with thick-oxide-coated wire brush cathodes have yielded thrustor operating lifetimes in excess of 1000 hr. A 0.5-cm-diameter cathode operated in a 5-cm thrustor for 1553 hr, and a 1-cm-diameter cathode operated for 3903 hr in a 7.5-cm-diameter thrustor simulator. Another nominal 1-cm-diameter cathode operated 1250 hr in a 20-cm-diameter thrustor. The radial wires in the brush design provided thermal and electrical conduction paths and reduced arc damage significantly. Each brush cathode at failure contained one-third or more of the original quantity of oxide. (STAR)

18887 (NASA-TN-D-3332) SURVEY OF ELECTROMAGNETIC ACCELERATORS FOR SPACE PROPULSION. Domitz, Stanley; Kosmahl, H. G.; Ramins, Peter; Stevens, N. John (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1966. 126p. CFSTI $1.60 cy, $1.00 mn.

A survey of the experimental status of electromagnetic or plasma accelerators is presented. This survey is limited to the major programs of recent years on plasma accelerators for spacecraft propulsion and does not cover the purely research activities in plasma physics. At present plasma accelerators are at the stage of demonstrating feasibility collecting performance data and investigating the problems of operation. A broad approach covering a wide range of input power requirements and types of accelerators is being pursued. There is, however, a definite tendency towards devices using coaxial geometry, minimum electrode areas, and short interaction lengths. (auth)

18888 ALTERNATING CURRENT CROSSED-FIELD PLASMA ACCELERATOR. Duclos, Donald P. (Electro-Optical Systems, Inc., Pasadena, Calif.). J. Spacecraft Rockets, 3: 141-2(Jan. 1966).

The feasibility of an a-c magnetogasdynamic plasma accelerator was investigated. As a thruster for space vehicles, the a-c accelerator could operate directly on the power generated by a power system that uses an alternator such as Systems for Nuclear Auxiliary Power (SNAP 50). Power control equipment would be simpler, less expensive, and more efficient than d-c conversion equipment. A d-c crossed-field accelerator, previously used for plasma diagnostic studies, was used for the experiments. The maximum exhaust velocity obtained from the thrust measurements was about 1900 msec, which is also comparable to the value obtained for d-c operation. For a-c operation, the arc jet thrust was increased by a maximum factor of about 1.4. The total voltage drop across the accelerator channel increased with the magnetic field, as expected for a crossed-field accelerator, and was about 30% higher than the voltage drop for d-c operation. Thrust efficiency of the accelerator was low, the measured values being less than 1%. This is attributed in part to the large Hall parameter. These experiments indicate that an a-c accelerator may produce about the same thrust (or exhaust velocity) as a d-c accelerator, but further work is required to determine how closely the a-c efficiency can be made to approach d-c values. (BBB)

Vacuum Engineering

18889 (LNF-65/38) LE POMPE AD ADSORBIMENTO. (Adsorption Pump). Note No. 294. Chimenti, V. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Oct. 26, 1965. 16p. Dep. mn.

The operating principles of the adsorption pump are outlined, and some data obtained in the application of the adsorption pump to the adone chamber are presented. (D.C.W.)

18890 ULTRAHIGH VACUUM IN AN UNBAKED APPARATUS. Gerasimov, L. L.; Danilova, N. P.; Shal'nikov, A. L. (Moscow State Univ.). Cryogenics, 5: 337-8(Dec. 1965).

A number of experiments are presented on the production of an ultrahigh vacuum, using low temperatures, in an unheated apparatus put together with rubber packing. (B.G.D.)

18891 DEVELOPMENTS IN HIGH-TEMPERATURE ULTRAHIGH-VACUUM FRICTION STUDIES. Kellogg, L. G. (Atomics International, Canoga Park, Calif.). Park Ridge, Ill., American Society of Lubrication Engineers, 1965, Preprint No. 65AM 6A1, 10p. (CONF-650547-1). ORINS.

From American Society of Lubrication Engineers, 20th Annual Meeting, Detroit.

Experimental studies were conducted to determine what materials can be used to provide bearing compatibility on nuclear reactors in space. Screening tests were conducted on sixty-seven material pairs in sliding couple at ultra-high vacuum. The friction couples are categorized into seven groups: metal vs metal, metal vs metal with dry lubricants, metal vs carbon, ceramic vs ceramic, ceramic vs ceramic with dry lubricants, metal vs ceramic, and ceramic vs carbon. Special tests were conducted using contaminant films with all groups. Data are presented to illustrate the effects of vacuum on sliding friction and the effects of vacuum on surface film formation. Results indicated that carbon-graphites and sodium-silicate bonded dry-film lubricants provide relatively low friction in vacuo at 1000°F, when coupled with Al_2O_3 (flame-sprayed) surfaces. (auth)

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

Refer also to abstracts 18199 and 18631.

18892 (NYO–3450–1, pp 41–89) TRACE ELEMENT ECONOMY IN THE OCEANS. Turekian, Karl K.; Schultz, Donald F. (Yale Univ., New Haven, Conn. Dept. of Geology).

The effects of transport, removal at specific locations, and rates of supply on the trace-element composition of deep-sea sediments, ocean waters, and fresh waters are discussed. The geochemistry of deep-sea sediments is also considered in constructing a model of trace element economy on the ocean bottom. Evidence is given to show that certain elements are brought to the sea by streams and are removed at various loci away from the continents. Variations in the concentrations of Sr and Ca can be accounted for primarily in the deep-sea sediments, with the nearshore removal of these elements occupying a subordinate role. Variations in barium concentration of sea water can be expected because of the low concentration in ocean water. Data on Rb and Ce indicate that no strong specific removal or supply loci or processes are operative. Increases in the silver concentration with depth in areas of high biological productivity indicate that silver is transported downward and dissolved. (P.C.H.)

18893 (NYO–3450–1, pp 131–48) SULFUR ISOTOPES IN THE MARINE ENVIRONMENT. Jensen, M. L. (Yale Univ., New Haven, Conn. Dept. of Geology).

The biogeochemical cycle of sulfur is discussed, with special attention given to the portion of the cycle pertaining to the marine environment. Experiments were performed in which mud and sea water were used in order to closely approximate isotopic behavior as it occurs in nature. The enrichment of ^{32}S in hydrogen sulfide was measured. These results were used along with studies on sulfur of magmatic hydrothermal origin to construct a preliminary biogeochemical cycle for sulfur. (P.C.H.)

18894 (NYO–3450–1, pp 169–84) RADIOGENIC LEADS OF THE CANADIAN AND BALTIC SHIELD REGIONS. Chow, Tsaihwa J. (Scripps Institution of Oceanography, La Jolla, Calif.).

The geochemical significance of lead isotopes in the sediments derived from the Canadian and Baltic Shields is discussed. A geochemical model was constructed regarding the relation among the uranium, thorium, and lead in the shield. From the isotopic variations of lead in the pre-Cambrian Shield, information was obtained as to the formation of the earth's crust and the mechanism of lead ore deposition. Lead evolution diagrams are illustrated. (P.C.H.)

18895 (NYO–3450–1, pp 217–76) MANGANESE–IRON ACCUMULATIONS IN THE SHALLOW MARINE ENVIRONMENT. Manheim, F. T. (Woods Hole Oceanographic Institution, Mass.).

Studies were made to support the suggestion that deep-sea concretions are not unique forms, but simply are members of a family of analogous occurrences of Mn–Fe oxides and hydrous oxides presently forming under a variety of conditions in many parts of the world. As a whole, shallow marine and nearshore concretions have higher iron content and lower oxidation states than open ocean forms. However, marked variations in Mn/Fe ratio are possible locally and regionally. Co, Ni, and other trace concentrations in Baltic nodules range from less than $\frac{1}{10}$ of the open ocean average to 0.3% Ni and 0.2% Co. Microorganisms are important in the Fe and Mn cycles, but appear to be more effective in helping dissolve metals (especially in interstitial waters) than in precipitating them as oxides. The major source of metals appears to be the continents. The concentration of Fe and Mn is much larger in nearshore and continental bottom waters and interstitial waters than in the deep ocean, but Co, Ni, and other trace elements may have similar concentration ranges. (151 references). (P.C.H.)

18896 (NYO–3450–1, pp 277–374) ISOTOPIC OCEANOGRAPHY: DEUTERIUM AND ^{18}O VARIATIONS IN THE OCEAN AND THE MARINE ATMOSPHERE. Craig, H.; Gordon, L. I. (Scripps Institution of Oceanography, La Jolla, Calif.).

Investigations on ^{18}O variations and their direct relation to paleotemperature studies which require a knowledge of the oxygen isotope variations in the sea in space and time are reported, along with ocean-atmosphere exchange of water. Discussion is limited to surface and deep water samples. The effects of permanent ice fields and isotopic-salinity relations are considered. An atmosphere-sea exchange model is given. In summary, the isotopic variations in the ocean proper are extremely small, even on the scale of isotopic geochemistry. The principal deep water masses of the sea differ by only about 0.3 per mil in oxygen-18 content and about 3 per mil in deuterium content. (P.C.H.)

18897 (ORNL-P–2006) PROJECT SALT VAULT: EFFECTS OF TEMPERATURE AND RADIATION ON PLASTIC FLOW AND MINE STABILITY. Bradshaw, R. L.; Lomenick, T. F.; McClain, W. C.; Boegly, W. J. Jr.; Empson, F. M.; Parker, F. L. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 20p. (CONF-660208–10). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

In mines in flat-lying salt deposits, heaving floors and sagging roofs can prove hazardous. The effects of temperature and load stress (in roof-supporting pillars) on such stability problems were studied by means of model pillars. Also, the effects of radiation (doses up to 5×10^8 R) on small test specimens were investigated. Operation of the radioactive and electrical arrays in Project Salt Vault did not reveal any significant effect of radiation on the salt flow or stability (as of January 1, 1966). However, thermal stresses from the heat in the floor were found to be transmitted to the roof, resulting in a fivefold increase in the rate at which the roof is sagging. No problems due to the increased flow are anticipated, either in the demonstration or in a properly designed actual disposal facility, but the need for careful study of such effects is underscored. (auth)

18898 A SYSTEM OF NOMENCLATURE FOR RARE-EARTH MINERALS. Levinson, A. A. (Gulf Research and Development Co., Pittsburgh). Amer. Mineral., 51: 152–8(Jan.–Feb. 1966).

Numerous rare-earth element analogues have been found for well-established rare-earth minerals. In order to prevent a multitude of impractical names, a system of nomenclature is proposed. A group name, e.g., monazite, is suggested for rare-earth minerals for which the rare-earth element distribution has not been determined. A species name, e.g., monazite-(Ce), monazite-(La), etc., is suggested for rare-earth minerals for which the rare-earth element distribution has been determined; the species name is obtained by appending the chemical symbol of the predominant rare-earth element to the group name. (auth)

18899 THERMOELASTIC STRESSES DUE TO A RADIOACTIVE INCLUSION. Jobert, G.; Le Mouel, J. (Institut de Physique du Globe, Paris). Ann. Geophys., 21: 420–7(July-Sept. 1965). (In French).

Attempts have been made to describe thermoelastic forces below the Earth's crust by a simple model portraying the continental crust as a semielliptical cylinder in an elastic half space of differential heat conductivity. Radioactive production of heat is then assimilated into this model. Thus a cylindrical half-elliptic inclusion with uniform radioactivity is visualized as imbedded at the surface of an elastic nonradioactive half-space. The stresses due to the transition from an initial state, when the temperature was

uniform in both media, to a permanent state, are computed. This analysis indicates that the differential thermoelastic stresses are maximum at the center of the ellipse and very concentrated at the surface. With numerical values convenient for an Earth crust model (width of the continent 3 Mm, depth 30 km), the extension stress is over 2 kbar at the center. However, in this model the suboceanic radioactivity, distributed over a much greater depth, is not taken into account. (BBB)

18900 RARE-EARTH ELEMENTS CONTENT IN ECLOGITES FROM NOWA WIES IN THE REGION OF SNIEZNIK KLODZKI. Bakun-Czubarow, N. (Inst. of Geological Sciences, Warsaw). Bull. Acad. Pol. Sci. Ser. Sci. Geol. Geographr., 13: 187-94(1965).

Two samples of eclogites were analyzed as typical for Nowa Wies; they were composed of parallel bands of pink almandine-pyrope garnet and light-green omphacite. Carinthine and zoisite occurred only in small amounts. The total content of rare earth elements (REE) in the eclogites from Nowa Wies (about 24 ppM) did not vary essentially from values given previously for basic and ultrabasic rocks. The ratio of the cerium group to the yttrium group of rare earths (~0.94) showed that the eclogites from Nowa Wies, compared to other basic and ultrabasic rocks, were richer in rare earths of the yttrium group. The total content of REE and the ratio of the cerium to the yttrium group did not, however, characterize the distribution of these elements in the rocks. The use of REE contents normalized to Nd and of their ratio enabled establishment of essential differences between the distribution of REE in the eclogites from Nowa Wies and those from South Africa. The eclogite from Nowa Wies compared with that from South Africa displayed a distinct maximum for Sm–Gd–Y–Dy. Both eclogites belong to different genetic groups of these rocks. Results from the comparison of absolute content of REE in eclogites from Nowa Wies and in their rock-forming minerals showed that garnets and omphacites are not the sole bearers of rare earths in these rocks. REE are probably concentrated in zoisite and in the rare accessory minerals apatite and zircon. (TCO)

18901 ABOUT THE MIGRATION OF RADIOGENIC ^{129}Xe IN METEORITES. Brandt, S. B. (Inst. of Geochemistry, Irkutsk, USSR). Geokhimiya, No. 1, 25-9(Jan. 1966). (In Russian).

Studies were made on the migration kinetics of radiogenic gases in crystal lattices. By means of a construction procedure, the bulk content of ^{129}Xe in meteorites is divided into two parts, having activation energies of diffusion 3 to 6 and 34 to 80 kcal/mole, respectively (the first part is referred to as an unstable zone, the second as a stable zone). ^{129}Xe contained in the unstable zone can be lost by meteorites due to radiation heat in space. Cosmogenic time intervals should hence be computed involving the xenon-iodine ratio of the stable zone only. Activation energies of diffusion of such radiogenic atoms as He–Ar–Xe are quite commensurable in spite of a 30-fold ratio of masses. The vacant lattice site mechanism of transportation is believed to explain this experimental situation. (auth)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY

Refer also to abstracts 18198, 19341, 19683, and 19684.

18902 (RLO–1725-41) DISTRIBUTION AT SEA OF COLUMBIA RIVER WATER AND ITS LOAD OF RADIONUCLIDES. Barnes, Clifford A.; Gross, M. Grant (Washington Univ., Seattle. Dept. of Oceanography). [1966]. Contract AT(45-1)-1725. 12p. (CONF-660507-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Presentation at Symposium for the Disposal of Radioactive Wastes into Sea, Oceans, and Surface Waters, Vienna.

Properties, distribution, and movement of Columbia River water in the Northeast Pacific Ocean and of the sediments near the river mouth were investigated. Distribution of salinity, nutrients, chlorophyll a, fission products from atmospheric fallout, and neutron-activation products from the Hanford reactor are reported. Surface salinities near the mouth of the river were generally under 35‰. Studies of river discharge yielded two periods of peak flow, the highest being from mid-May until mid-June. During late spring and summer the Columbia River contributes over 90% of the runoff reaching the Northeast Pacific Ocean between 38° and 48°N. Distinctive features of the discharge plume for late summer 1961 are plotted. Distribution of salinity, nitrate, phosphate, and chlorophyll a in surface waters near the Columbia River were determined during late summer 1961 and in winter 1962. Radionuclide contamination by ^{51}Cr, ^{95}Zr and ^{95}Nb was detected in surface waters, and ^{95}Zr, ^{95}Nb, ^{106}Ru, and ^{144}Ce were found in sediments. The vertical distribution and abundance of fission products in sediment cores provide possible means of determining the rate of sediment accumulation in the region and of evaluating the effects of the vertical mixing of sediment due to the activities of marine burrowing organisms. Preliminary data suggest that rapid vertical mixing extends to a depth of at least 2 cm in the cores. Radionuclides from the Hanford effluent provided the opportunity to study the distribution of Columbia River sediment on the Continental Shelf and its movement in the area. Zinc-65 proved to be the most valuable of the neutron-activated products in this respect. (H.G.D.)

18903 (RLO–1750-3) ARTIFICIAL RADIONUCLIDES IN MARINE ORGANISMS IN THE NORTHEAST PACIFIC OCEAN OFF OREGON, U. S. A. Carey, Andrew G. Jr.; Pearcy, William G.; Osterberg, Charles L. (Oregon State Univ., Corvallis. Dept. of Oceanography). Mar. 3, 1966. Contract AT(45-1)-1750. 20p. (CONF-660507-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Presentation at Symposium for the Disposal of Radioactive Wastes into Sea, Oceans, and Surface Waters, Vienna.

Although ^{65}Zn is found in all groups of animals in the pelagic and benthic environments, in higher concentrations in some animal groups than others, the highest levels measured are still very much below hazard levels. Highest concentrations of ^{65}Zn in the fauna usually were found near the Columbia River, a point source. However, pelagic organisms further to the south showed high concentrations during the summer. Bathymetric, seasonal and diurnal effects on the distributions of radionuclides in the biota are interconnected, particularly in the macroplankton and nekton. Zinc-65 stratified in the pelagic organisms in the summer, was uniformily distributed with depth in the winter. Concentrations were higher in the macroplankton and nekton in surface waters at night, and decreased with depth in the benthos. Zirconium-95–Niobium-95 were found at all depths, though in the pelagic fauna they were in higher concentration in surface waters. Zinc-65 was found throughout the food chain, while ^{95}Zr–^{95}Nb decreased rapidly after the first two trophic levels. (H.G.D.)

18904 THE DETERMINATION OF ACTINON IN ATMOSPHERIC AIR. Fontan, Jacques; Birot, Andre; Blanc, Daniel; Guedalia, Daniel (Centre de Physique Nucleaire, Toulouse). Compt. Rend., Ser. B, 262: 307-8(Jan. 24, 1966). (In French).

A method for the direct and continuous determination of radon and thoron was adapted to the detection of actinon (^{219}Rn) at ground level. The activity from the actinon was separated from that of the radon and the thoron by means of two decay chambers placed in series. The measurements show that it is only in certain cases that actinon can be released into the atmosphere. (tr-auth)

18905 RADIUM CONCENTRATIONS IN WATERS OF THE AZOV SEA AND OF CERTAIN LAGOONS. Lazarev, K. F.; Nikolaev, D. S.; Grashchenko, S. M.; Drozhin, V. M. Dokl. Akad. Nauk SSSR, 164: 1151-3(Oct. 11, 1965). (In Russian).

The average ^{226}Ra content of the waters of the Black Sea, $(1 \pm 0.1) \times 10^{-13}$ g/l, is somewhat higher than that of oceans,

even though the salinity is lower. The salinity of the waters of the Azov Sea is about 40% lower, reaching practically zero level near the estuary of the Don River. On the other hand, the salt content in the lagoons is much higher. The possible correlation between salinity and radium content was investigated in sea water samples collected at the surface during the summer of 1959. Measurements with scintillation counter revealed that the Ra content of the Sea of Azov is fairly uniform $(1.4 \pm 0.15) \times 10^{-13}$ g/l; this concentration was reduced locally by dilution caused by river waters. No correlation could be established between salt content and Ra concentration of the waters. The Ra concentration in the waters of the Azov Sea corresponds to 20% of that in equilibrium with the uranium in the water; this figure is 15% in the Black Sea waters. (TTT)

18906 UPTAKE OF RADIOACTIVE FISSION PRODUCTS BY FIELD CROPS. REPORT I. ACCUMULATION OF RADIOACTIVE FISSION PRODUCTS BY GRAIN AND OIL-BEARING CROPS. Il'ina, G. V.; Rydkii, S. G. Federation Proc., Transl. Suppl., 25: T123-T127(Jan.-Feb. 1966).

Translated from Vestn. Moskov. Univ. Ser. VI: Biol. Pochvoved., 20: 42(1965).

The uptake of radioactive fission products was studied in grain crops, buckwheat plants, mustard, millet, bristle grass, and sunflowers. Results showed that grain and oil-bearing crops differ in their ability to extract radioactive fission products from the soil. Uptake of these substances began early and continued throughout the growing period. It was further noted that various plant tissues accumulated different amounts of ^{90}Sr, the leaves having the highest content and the stems and seeds the lowest. The highest ^{90}Sr content per unit dry matter was seen in buckwheat, mustard, and sunflowers. Removal of fission products with the harvest of the crops was low. (H.G.D.)

18907 DETERMINATION OF ^{22}Na IN RAIN WATER. Argiero, L.; Lo Moro, A.; Manfredini, S.; Palmas, G. (CAMEN, Pisa, Italy). Health Phys., 12: 566-70(Apr. 1966). (In Italian).

Sodium-22 content and gamma spectra were determined in rain water collected at Livourne. The concentration of ^{22}Na was 0.84pC/l. (H.G.D.)

18908 MAGNESIUM ISOTOPE RATIOS IN NATURAL SAMPLES. Catanzaro, E. J.; Murphy, T. J. (National Bureau of Standards, Washington, D. C.). J. Geophys. Res., 71: 1271-4(Feb. 15, 1966).

Magnesium isotope ratios of 60 natural samples, including carbonate, evaporite, hydroxide, silicate, oxide, seawater, brine, meteorite, and biological samples, were measured by thermal emission mass spectrometry. Statistical analysis of the data reveals no evidence of variations among the natural samples or between any of the natural samples and a reference sample of magnesium metal. The 95% confidence limits for each natural sample are ±0.11% and ±0.22% for the $^{24}Mg/^{25}Mg$ and $^{24}Mg/^{26}Mg$ ratios, respectively. (auth)

18909 NUCLEAR STUDIES IN CHEMISTRY AND BIOLOGY. Rafter, T. A. (Inst. of Nuclear Sciences, Lower Hutt, New Zeal.). J. New Zeal. Inst. Chem., 29: 64-73(Apr. 1965).

Some experiments on isotopes of H, C, O, N, and S are presented and discussed. When snow was collected from Mt. Cook (New Zealand) at various altitudes, it was found that the tritium concentration is greatest at the highest altitude. Ice from a snow mine at the South Pole was also examined. A considerable amount of tritium was found, which could mean either that the samples were contaminated in some way, or that the snow breathes and water vapor is carried by air to depths in the ice cap. Some experiments on the isotopes of sulfur in meteorites are also described. When the sulfur isotopes in meteorites were examined, no matter which type, the results were always very close to the same ratio for $^{34}S/^{32}S$ or $^{36}S/^{32}S$. As the meteorite is orbiting around the sun, it is hit by cosmic particles that can transmute iron (the major constituents of iron meteorites) to elements of lower atomic weight. One of these elements is chlorine-36 with a half life of 308,000 years; ^{36}Cl decays to the inert gas ^{36}Ar. By measuring the radioactivity from ^{36}Cl and the quantity of ^{36}Ar gas formed, it was possible to determine how long the meteorite existed in the solar system before hitting the earth. Research on the sulfur isotopes of New Zealand's volcanic and hydrothermal regions, of the rich sulfide mineral deposits of Australia, of sulfur from the volcanoes of the Pacific, and of the sulfate falling in rains and snows is also discussed. (TCO)

18910 IDENTIFICATION OF ALPHA EMITTING NUCLIDES IN FALLOUT. Allwein, M.; Paugger, P.; Staeudner, R. (Gesellschaft fuer Nucleonic und Electronic mbH, Munich). Kerntechnik, 8: 86(Feb. 1966). (In German).

Between October 15 and October 29, 1965, a significantly high α activity of unknown origin was found in fallout residue. Determination of the identity of this unknown α activity is reported. Measurement of the α activity gave a maximum energy at 5.14 ± 0.05 Mev. From the known α spectra of isotopes, the unknown emitter could be ^{239}Pu with radiation at 5.15 Mev or ^{240}Pu with α rays at 5.16 Mev. (J.S.R.)

18911 ^{109}Cd IN NEW ZEALAND RAINWATER. McCallum, G. J.; Woodward, R. N. (Inst. of Nuclear Sciences, Lower Hutt, N. Z.). Nature, 209: 69-70(Jan. 1, 1966).

^{109}Cd was detected in rainwater collected at the Institute of Nuclear Sciences Site, Lower Hutt, New Zealand. Measurements were made on monthly rainwater samples collected between April and October 1964. Data are presented in tables and graphs. (M.C.G.)

18912 RADIONUCLIDE FRACTIONATION IN AIR-BURST DEBRIS. Freiling, E. C.; Kay, M. A. (Naval Radiological Defense Lab., San Francisco). Nature, 209: 236-8(Jan. 15, 1966).

Radiochemical data from fifteen air burst detonations were used for an analysis of the correlations between radionuclide fractionation ratios, and to test the variation of the correlation parameters with total weapon yield, and the hypothesis that nuclides of certain groups do not fractionate with one another. Standard statistical methods were used. The range of fractionation and the cumulative ratios for each nuclide are listed. Regression slopes for yield dependence and cumulative slopes are also listed. A comparison of chain volatility inferred from fractionation behavior with thermodynamic volatility of the parent is shown graphically. (J.F.P.)

18913 HIGHLY FRACTIONATED NUCLEAR DEBRIS RESULTING FROM THE VENTING OF A SOVIET UNDERGROUND NUCLEAR TEST. Koyama, Seitaro; Sotobayashi, Takeshi; Suzuki, Toshio (Niigata Univ., Japan). Nature, 209: 239-40(Jan. 15, 1966).

Radioactivity from a large-scale underground test was collected in rain water. Radioactive dry fallout was also observed. The locations where wet or dry fallout from the Soviet underground test was observed during January, 1965 are shown. Since the testing date and site of this test explosion are known, the debris demonstrates the radiochemical composition of fallout from a distant underground test and the duration of atmospheric contamination caused by such a test. The results of a radiochemical analysis are given, and a decay curve of the samples is shown. The atmospheric mean time of residence of strontium-89 from this test is also given. (J.F.P.)

18914 RADIOLOGICAL HEALTH DATA. Volume 6, Number 7. Public Health Service, Washington, D. C., July 1965. 78p. GPO $0.50.

Data are presented on the gross β activity in airborne particulates, precipitation, and air collected at various locations throughout North America in March, 1965; the radioactivity in milk samples collected from Oct. through Dec., 1964; radionuclides in U. S. diets during 1963 and 1964; the gross radioactivity and ^{90}Sr content in surface waters in Jan., 1965; and the content of ^{90}Sr in human bones in 1964 and 1965. Environmental levels of radioactivity at the Union Carbide Nuclear Co., Oak Ridge, Tenn., and Paducah, Ky., plants and at the Goodyear Atomic Corp.,

Piketon, Ohio, during 1964 are reported. Two low yield underground nuclear tests were announced during June, 1965. Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 18967–18969.

18915 RADIOLOGICAL HEALTH DATA. Volume 6, Number 8. Public Health Service, Washington, D. C., Aug. 1965. 58p. GPO $0.50.

Data are presented on the gross β activity in airborne particulates, precipitation, and samples of air collected at various locations throughout North America during April, 1965; the content of ^{131}I, ^{137}Cs, and ^{140}Ba in samples of milk collected during April, 1965; an estimation of the radiation dose to the population from radionuclides in milk from April 1964 through April 1965; the ^{90}Sr content of selected foods from 1962 through 1964; and the radioactivity in surface waters of the U. S. in Feb. 1965. Environmental levels of radioactivity at the General Electric Company, Pinellas Peninsula Plant, Fla., the Savannah River Plant, Aiken, S. C., and the Shippingport Atomic Power Station, Penna., during the last half of 1964 are reported. One low-intermediate yield range underground nuclear test was announced during July, 1965. Separate abstracts were prepared on three sections of this report. (C.H.)

For abstracts of individual sections see: 18916, 18970, and 18971.

18916 AUTORADIOGRAPHIC EXAMINATION OF AIRBORNE FALLOUT FOR OCTOBER–NOVEMBER 1964. Shleien, B.; Bernard, L.; Friend, A. G. (Northeastern Radiological Health Lab., Winchester, Mass.). Radiol. Health Data, 6: 419-21(Aug. 1965).

Prior to and following the Oct. 1964 detonation of a nuclear device on the Chinese mainland, autoradiographic techniques were used to study radioactive particulates in surface air samples collected in mass. Data are presented on the gross β activity per unit volume of air and the number of radioactive particles. It was concluded that autoradiographic examination of airborne radioactive particles during an intrusion of fresh fallout indicates changes in the specific activity per particle and the concentration of radioactive particles relative to gross β activity. (C.H.)

18917 RADIOCARBON IN SURFACE AIR. Drobinski, J. C. Jr. (Northeastern Radiological Health Lab., Winchester, Mass.). Radiol. Health Data, 6: 605-6(Nov. 1965).

Prior to 1950, the natural $^{14}CO_2$ content of the troposphere and lower stratosphere was in a steady-state equilibrium that had probably existed for at least 300,000 years. The detonation of fusion and high-yield fission devices, which began in 1952, added macro amounts of ^{14}C to the stratosphere, followed by a gradual entrance into the troposphere. Since very little carbon is absorbed through respiration its principal route of entry into man is through the food chain by the incorporation of $^{14}CO_2$ into plant tissues through photosynthesis. Although the dose rate from ^{14}C is very low, the half life of 5,740 yr make it probably the most significant radionuclide produced by nuclear detonations from the genetic standpoint. Results are reported from measurements of the content of ^{14}C in the troposphere from 1956 through 1962 and in surface air from Jan. 1964 to April 1965 that indicate an increase over the period of study, particularly in March 1964. It is postulated that this increase indicates the entrance into the troposphere of ^{14}C from the stratospheric inventory. Procedures used for sample collection and analysis are described. (C.H.)

18918 RADIOLOGICAL HEALTH DATA. Volume 6, Number 12. Public Health Service, Washington, D. C., Dec. 1965. 66p. GPO $0.50.

Data are presented on the fallout radioactivity in samples of air, precipitation, milk, food, and water collected throughout North America during 1965. Data are included on environmental levels of radioactivity at Brookhaven National Lab., and the Dow Chemical Co., Rocky Flats Plant, from Jan. through June 1965. One low-yield underground nuclear test was announced during Nov. 1965. (C.H.)

For abstracts of individual sections see: 18233, 18234, 18919, and 18920.

18919 DEPOSITION OF FALLOUT ^{137}Cs AT FORT COLLINS, COLORADO, 1962–1964. Wilson, Daniel W.; Ward, Gerald M.; Johnson, James E. (Colorado State Univ., Fort Collins). Radiol. Health Data, 6: 675-6 (Dec. 1965).

Data are presented on the content of ^{137}Cs in precipitation at Fort Collins, Colorado, from 1962 through 1964. (C.H.)

18920 SUMMARY OF RESULTS OF INSTITUTIONAL TOTAL DIET SAMPLING NETWORK, 1961–1964. Grundy, R. D.; Calvert, C.; Berger, A. G. (Radiation Surveillance Center, Washington, D. C.). Radiol. Health Data, 6: 691-8(Dec. 1965).

Data are presented on the content of Ca, K, ^{89}Sr, ^{90}Sr, ^{131}I, ^{140}Ba, and ^{137}Cs in institutional diet sampled at 21 institutions throughout the U. S. from 1961 through 1964. Atmospheric nuclear testing during late 1961 and 1962 resulted in a general increasing trend for radionuclide levels until 1964, with maximum intake of shorter-lived nuclides such as ^{89}Sr, ^{131}I, and ^{140}Ba occurring during 1962 and 1963 and an apparent decrease in ^{90}Sr and ^{137}Cs intakes in the fall of 1964. (C.H.)

18921 BULLETIN OF THE ATMOSPHERIC RADIOACTIVITY. Taiki Hoshano Kansoku Seiseki, No. 40, 1-78 (Jan.-Mar. 1965).

Routine observations of fallout radioactivity in Japan between January and March 1965 are reported. Aspects of the programs described include: the fallout radioactivity monitoring system; regular and fixed volume collection of rain water; dust collection methods; collection of large amounts of rain water and falling dust by the water-pan method; sample boiling and fixation; testing with temporary standard specimens; measurement of sample radioactivity and the statistical random deviation; observation of radioactive decay and elimination of background activity; and exchange of measuring standards. (H.G.D.)

18922 ASSAY OF ^{90}Sr IN HUMAN BONE IN THE UNITED KINGDOM. Results for 1964, Part II. Medical Research Council Monitoring Report Series No. 11. London, Her Majesty's Stationery Office, 1965. 21p. 1s. 9d.

Strontium-90 assays were performed in samples of human bone from subjects who died in the second half of 1964 by the UKAEA and in Glasgow. Separate values for the 6 to 23 months age group are included because samples from this group have resulted in a higher mean value for the 0 to 4 age group in Glasgow than in the UKAEA series. During the second half of 1964 the ^{90}Sr levels in bone continued to reflect the effects of the 1961 and 1962 nuclear weapons tests. Most of the means varied only slightly from those for the previous six months or those for the corresponding months in 1963. Patterns of change in ^{90}Sr concentration with age are discussed. (H.G.D.)

Techniques and Equipment

Refer also to abstract 18710.

18923 (N-65-22654) PRECURSOR SHOCKS PRODUCED BY A LARGE-YIELD TNT EXPLOSION. Dewey, John M. (Suffield Experimental Station, Ralston (Alberta)). Mar. 1965. 16p.

Precursor shocks, normally associated with surface burst or low-level nuclear explosions, have been explained as effects of the intense thermal radiation produced by a nuclear explosion, although an alternative theory suggests that the primary cause may be a ground surface wave, with some enhancement by a strong thermal gradient. In July 1964, a 500-ton TNT surface burst charge was detonated. High-speed photographs of the explosion show that along a limited number of radii, dust clouds moved out ahead of the main shock and that those clouds were enveloped by a shock

wave. Some of these dust clouds reached a height of about 50 ft before arrival of the main shock. High-speed films taken from a position close to the charge show that, in some regions near to the ground, the precursor is downwind facing, and a Mach stem appears to have been produced. In all cases the precursors originated along well-compacted earth roadways running radially from the charge center. (STAR)

18924 (NYO–1669-11) INVESTIGATIONS IN ISOTOPE GEOCHEMISTRY. Annual Progress Report No. 11. Gast, Paul W.; Clark, G. S.; McDowell, F. W.; Abdel-Monem, A.; Swainbank, I.; Olsson, I. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Jan. 1966. Contract AT(30-1)-1669. 167p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The results are reported for studies on: age of plutonism and mineralization in the western United States; geochronology of basement rocks of the Manhattan Prong and western Conn.; paleogeography and K–Ar ages of sediments in N. J. triassic basin; and ages of zircons from rocks giving multiple ages by Rb–Sr geochronology. Preliminary results on the lead isotope composition of carbonatites are included. (P.C.H.)

18925 (NYO–3450-1, pp 1-27) THE DATING OF MOLLUSKS FROM RAISED MARINE TERRACES BY THE $^{230}Th/^{234}U$ METHOD. Thurber, David L. (Columbia Univ., Palisades, N, Y. Lamont Geological Observatory).

Use of the $^{230}Th/^{234}U$ method for dating mollusks from raised marine terraces is described and evaluated. To this end, uranium and thorium isotopes and radium were determined in marine shells. Ages are calculated from the $^{230}Th/^{234}U$ ratio, assuming that the measured $^{234}U/^{238}U$ ratio is the result of ^{234}U decay from an initially greater ^{234}U excess. Within limitations, the results showed that ages of marine mollusks on raised terraces appear to group at 80,000 to 90,000 years, and at around 120,000 years. (P.C.H.)

18926 (NYO–3450-1, pp 29-40) DEPOSITION RATES BY THE PROTACTINIUM METHOD. Sackett, William M. (Tulsa Univ., Okla. Dept. of Chemistry).

Studies were made to determine the efficiency of ^{231}Pa as an index of time as compared to thorium-230. The method used in determining rates based on the distribution of unsupported ^{231}Pa activity in sediments is described. Although the specific activity of ^{231}Pa in sediments is very low and the separation of carrier-free Pa is relatively difficult, it was found that ^{231}Pa may be determined routinely and seemingly with good precision. Ages by the Pa method agreed within 30% of radiocarbon ages on four cores analyzed. (P.C.H.)

18927 (RM–4942(RAND)) NUMERICAL PROGRAMS FOR SOLVING HYPERBOLIC SYSTEMS BY THE METHOD OF CHARACTERISTICS: RADIO EMISSION FROM A NUCLEAR EXPLOSION: PART I. Peebles, G. H. (RAND Corp., Santa Monica, Calif.). Mar. 1966. 57p.

Two programs are presented which calculate the solution for a hyperbolic system of partial differential equations with three constant characteristic directions. The computations are on a net of characteristics of variable mesh, the size of the mesh being determined by a criterion of accuracy. The first program ranges over four mesh sizes; the second, over nine. (auth)

18928 EXPERIMENTAL ERRORS AND THE INTERPRETATION OF COMMON LEAD ISOTOPE ABUNDANCES IN LEAD ORES. Kovach, A. (Inst. of Nuclear Research, Debrecen). Acta Phys. Acad. Sci. Hung., 20: 121-31 (1966).

Experimental error sources, giving rise to incorrect model ages according to the Holmes–Houtermans model, are discussed. Special attention is paid to the apparent age anomalies caused by the inadequate resolution of the mass spectrometer. (auth)

18929 POTASSIUM–ARGON AND URANIUM–LEAD AGES FROM TWO LOCALITIES. Boutcher, Sheila M. A. (Univ. of Toronto, Canada); Davis, G. L.; Moorhouse, W. W. Can. Mineral., 8: 198-203(1965).

Attempts were made to determine, by comparing ages obtained from uranium-lead ratios of zircons, and potassium-argon ($^{40}Ar/^{40}K$) ages from metamorphic micas, whether there is a time interval of the order of one or more tectonic cycles between the time of crystallization of the detrital zircons, and the main period of folding and metamorphism of the conglomerates in which they occur. Although some difference in the two dates was found, for a conglomerate of each type, it does not exceed the length of a tectonic cycle, in the broadest sense. Detrital zircon from a Timiskaming conglomerate near Kirkland Lake, Ontario, gave a uranium-lead age of 2700 Myr ±3% and muscovite from the same rock gave a potassium-argon (metamorphic) age of 2410 ± 50 Myr. In Hastings conglomerate near Madoc, Ontario, detrital zircon age of crystallization was 1140 Myr ±3% and the potassium-argon ratio of muscovite indicated metamorphism at 898 ± 20 Myr. These source rocks formed in the same geological cycle, without the intervention of a major orogeny prior to sedimentation and final folding and metamorphism of the conglomerates. It was concluded that this preliminary attempt to investigate metamorphism failed to produce evidence of much older rocks in this part of the Grenville. As far as this conglomerate is concerned, it did not appear to have formed in the Archean or Huronian, but at a much later time, which can be regarded as truly Grenville. (BBB)

18930 STUDY OF THE VERTICAL WATER EXCHANGE IN THE OCEAN USING THE ^{90}Sr DISTRIBUTION DATA. Ozmidov, R. V.; Popov, N. I. (Inst. of Oceanology, Academy of Sciences, USSR). Fiz. Atmos. Okeana, 2: 183-90(1966). (In Russian).

The equation for mean vertical exchange of strontium-90 in the ocean is discussed. As a boundary condition the constant flux of the isotope through the ocean surface is applied. Using the known data on strontium-90 distribution the mean value of the vertical exchange coefficient for the central part of the North Atlantic ocean is obtained. The time variation of global strontium-90 concentration in the ocean is found. The theoretical curve is in a good agreement with empirical data for upper layers of the ocean. (auth)

18931 RADIOCARBON DATES OF THE LABORATORY OF THE GEOLOGICAL INSTITUTE. Cherdyntsev, V. V.; Alekseev, V. A.; Kind, N. V.; Forova, V. S.; Zavelskii, F. S.; Sulerzhitskii, L. D.; Churikova, I. V. (Geological Inst., Moscow). Geokhimiya, No. 12, 1410-22(Dec. 1965). (In Russian).

Sixty-one determinations of radiocarbon in various natural carbon-containing objects (wood, charcoal, peat, plant detritus, fossil soils, humusized loam, charred bones, fossil bones, shells of terrestrial mollusks, carbon dioxide gases) are presented. A wide choice of the material was made to show the suitableness for radiocarbon dating. The measurements were carried out on two settings of the same type by the benzene variant of the scintillation method. The maximum ages (48 hours of working and background sample measurements; the minimal counting rate exceeds the fourfold standards error) are 45 and 49 thousands of years. Material is presented on dating the upper-Paleolithic relics of the USSR. The ages of the investigated samples reach to 33 thousand years. Dates for Mesolithic and Neolithic relics were also obtained. Geological material from Eastern Siberia was investigated (to determine the chronology of the upper Pleistocene main events as well as some dates of volcanic activity). Preliminary data on the duration of the Kargin interstadial were obtained. (auth)

18932 THEORY OF NEUTRON LOGGING. II. Tittle, C. W. (Southern Methodist Univ., Dallas); Allen, L. S. Geophysics, 31: 214-24(Feb. 1966).

A new version of an analytical theory of epithermal-neutron logging is developed by application of steady-state one-group diffusion theory to a central point neutron source in concentric cylindrical regions. An axial source expansion is employed in order to determine the coefficients of the series solution for two regions and for three regions. Both are compared with experiments in laboratory models. Favorable results are obtained notwithstanding the limitations of diffusion theory and its inherent approximations. Application of the theory is made to a theoretical justifica-

tion of the dual-spaced neutron method of gas location, and a theoretical investigation of the effect of the rock matrix in clean limestone and sandstone. Additional flux groups and source energy groups are briefly discussed. (auth)

18933 LABORATORY PRODUCTION OF DIBORANE AND ACTIVATION OF SILICA–ALUMINA CATALYST FOR CONVERSION OF $C_2{}^{14}H_2$ TO $C_6{}^{14}H_6$: RADIOCARBON DATING BY LIQUID SCINTILLATION SPECTROMETRY. McDowell, L. L.; Ryan, M. E. (Dept. of Agriculture, Oxford, Miss.). Int. J. Appl. Radiat. Isotop., 17: 175-83 (Mar. 1966).

The conversion of acetylene (C_2H_2) to benzene (C_6H_6) using diborane (B_2H_6)-activated silica–alumina is employed in the synthesis of $^{14}C_6H_6$ for radiocarbon dating. A continuous process method is described for the routine laboratory production of diborane and the activation of the silica–alumina catalyst employed in this synthesis. The $^{14}C_6H_6$ is of sufficient purity that it can be directly used in counting natural ^{14}C by liquid scintillation spectrometry. Diborane (ca. 2 moles) is produced in a hood-mounted manifold by the reaction of sodium borohydride ($NaBH_4$) and boron trifluoride etherate [$BF_3(C_2H_5)_2O$]. Ten columns (51 mm OD × 300 mm long), each containing about 300 g of silica–alumina, are connected in series to accept the generated diborane. Each column, after final processing and introduction of $^{14}C_2H_2$, yields about 5 g of $^{14}C_6H_6$. Equipment requirements are not elaborate; the entire apparatus can be readily assembled from laboratory-fabricated glass components using brass tube quick-connectors and valves. Thus the procedure can be readily adopted by laboratories not having access to commercial diborane, or not having the interest and facilities for storing large quantities of commercial cylinder diborane for activating the silica–alumina. (auth)

18934 RADIOCARBON IN THE PACIFIC AND INDIAN OCEANS AND ITS RELATION TO DEEP WATER MOVEMENTS. Bien, G. S.; Rakestraw, N. W.; Suess, H. E. (Univ. of California, San Diego, La Jolla). Limnol. Oceanog., 10: Suppl., R25-37(Nov. 1965).

Since 1948, carbon-14 measurements on the bicarbonate of ocean water samples from the Pacific and Indian oceans have been carried out at the Scipps Institution of Oceanography, La Jolla, California. Previous reports of the results of these investigations have been confirmed and amended by many recent measurements. The method of extracting CO_2 from ocean water has been modified and perfected over the past years. The most notable results of the measurements concern the ^{14}C content of deep ocean water which can be interpreted unambiguously by considering the aging of the water during the time of movement from the Weddell Sea eastward and then northward into the North Pacific Ocean. (auth)

18935 ^{14}C DATING BY LIQUID SCINTILLATION COUNTING. I. SYNTHESIS OF METHANOL AND METHYL BORATE AND THEIR COUNTING EFFICIENCY. Yamada, Osamu; Higashimura, Takenobu; Sidei, Tunahiko (Kyoto Univ.). Radioisotopes, 15: 73-6(1966). (In Japanese).

Studies were made on ^{14}C-dating method by liquid scintillation counting. In this technique, samples of either large or small volume can be accommodated, and when using large amounts of samples, statistical errors in counting can be made smaller than in the case of gas counting. Methanol or methyl borate containing sample carbon were used as solvents because of ease of synthesis and effectiveness in counting. The CH_3OH was carefully purified and the purity was verified both by elementary analysis and by gas chromatography. The yield was about 70% of Ca^*CO_3. The scintillator containing methanol and toluene in the ratio of 1:1 showed counting efficiency of 26%. Methyl borate was prepared from methanol and B_2O_3. Counting efficiency of the scintillator containing 60% methyl borate and 40% toluene was 52%. (P.C.H.)

18936 FEYNMAN DIAGRAMS AND INTERACTION RULES OF WAVE-WAVE SCATTERING PROCESSES. Hasselmann, K. (Univ. of California, San Diego. Univ., Hamburg). Rev. Geophys., 4: 1-32(Feb. 1966).

The energy transfer due to weak nonlinear interactions in random wave fields is reinterpreted in terms of a hypothetical ensemble of interacting particles, antiparticles, and virtual particles. In the particle picture, the interactions can be conveniently described by Feynman diagrams, which may be regarded either as branch diagrams of the perturbation expansion or as collision diagrams. The derivation of the transfer expressions can then be reduced to a few general rules for the construction of the diagrams and the associated collision cross sections. The representation follows closely the standard treatment of nonlinear lattice vibrations, but the particle picture differs from the usual phonon interpretation of lattice waves. It has the unrealistic property that the energies and number densities of antiparticles are negative. This is offset by simpler interaction rules and a closer correspondence between the perturbation graphs and collision diagrams. The method is illustrated for scattering processes in the oceanic wave guide involving surface and internal gravity waves, horizontal currents (turbulence), seismic waves, and bottom irregularities. (auth)

18937 RADIOCARBON DATING IN THE PACIFIC. Shutler, Richard Jr. 9p. (CONF-650652-12). Gmelin, AED-CONF-65-158-4.

From International ^{14}C and ^3H Dating Conference, Pullman, Wash.

Based on ^{14}C dating the development of earlier man in the Pacific Islands area was established. Bones, shells, and crude tools and weapons were dated by the ^{14}C process. The bones, weapons, tools, and shells were uncovered at various depths, the deepest finding was reported at ~42 to 60 inches. The islands consisted of Australia, New Guinea, New Hebrides, Tonga, Samoa, Marquesas, Easter Island, New Zealand, and the Hawaiian Islands. Early man's beginnings, according to the ^{14}C ages, go back ~40,000 yr for one particular finding. The dating varies from ~ 1917 to 30,000 BC for the Pacific Islands. (F.J.H.)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY, METEOROLOGY, AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 18576, 18592, 18897, 19091, and 20228.

18938 (AD–629784) RADIOLOGICAL TARGET ANALYSIS PROCEDURES. Lee, Hong (Stanford Research Inst., Menlo Park, Calif.). Mar. 1966. Contract N228-(62479) 65421. 94p. (USNRDL-TRC-6).

A radiological target analysis procedure is presented which provides calculations of the relative exposure intensities within target complexes during the shelter period, the decontamination period, and the target reutilization period. These calculations are made by systematically determining the intensity at typical target locations as modified by fallout geometries, structural shielding geometries, and the movement of fallout by nature or by decontamination operations. The results are residual numbers for the three postattack periods that are specified in the general equation for exposure dose. Examples and sample calculations are included in each analytical step to provide not only illustrations of the procedures but also training aids for operational and planning personnel in RADEF systems. The latest information was included on several decontamination methods, with examples and sample calculations showing how decontamination operations may be scheduled, crew doses may be controlled, and recovery objectives may be achieved. A final step was the evaluation of several representative RADEF systems in terms of target analysis results, decontamination performance, and logistic limitations. The primary conclusion of the procedural effort reported here is that each RADEF system should be analyzed with its target area. The accuracy of the target complex analysis procedure is limited by the accuracy to which target complexes and fallout sources could be delineated. Nevertheless, the data obtained by the procedure can be coordinated with decontamination methods, manpower and other operational factors to provide effective RADEF planning and evaluation. (79 references.) (auth)

18939 (EUR–2642.f) QUATRIEME COLLOQUE SUR L'ASSURANCE DU RISQUE NUCLEAIRE, BERLIN, LES 8 ET 9 JUILLET 1965. (Fourth Colloquium on Nuclear Insurance, Berlin, July 8–9, 1965). (European Atomic Energy Community). Jan. 1966. 88p. (CONF-650725–1). Dep. mn.

The special position of the nuclear insurance market, the situation as regards conditions of competition, the assumption of risks by the state, the relationship of traditional insurance to nuclear insurance, and, in particular a draft skeleton third-party policy for nuclear hazards in nuclear plants are discussed. (TCO)

18940 (EUR–2747.f) ANALYSE COMPARATIVE DES REGLEMENTS DU TRANSPORT DES MATIERES RADIOACTIVES EN VIGUEUR DANS LES PAYS-MEMBRES DE LA COMMUNAUTE EUROPEENNE DE L'ENERGIE ATOMIQUE PAR RAPPORT AU REGLEMENT DE L'AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE. (Comparative Analysis of the Regulations in Force in the Euratom Member States Governing the Transportation of Radioactive Materials and Those Drawn up by the International Atomic Energy Agency). Da Novi, P. (European Atomic Energy Community). Feb. 1966. 242p. Dep. mn.

The regulations applying in the various countries of the European Atomic Energy Community with regard to the transportation of radioactive materials are compared as to the points in which they are similar to or diverge from the Regulations for the Safe Transport of Radioactive Materials, International Atomic Energy Agency, Vienna, 1965. (C.H.)

18941 (IDO–12047) CONTROLLED ENVIRONMENTAL RADIOIODINE TESTS AT THE NATIONAL REACTOR TESTING STATION, 1965 PROGRESS REPORT. Adams, D. R.; Bunch, D. F.; Gammill, W. P.; Hawley, C. A. Jr.; Markee, E. H.; Tiernan, M. W. (Idaho Operations Office (AEC), Idaho Falls. Health and Safety Div.). Feb. 1966. 47p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The CERT project consists of a series of planned releases of radioiodine over different vegetation and during various meteorological conditions, with the prime objective being to measure the relationships involved in the passage of radioiodine through the air-vegetation-cow-milk-human chain. The results of the first five tests in the series, which started in the spring of 1963 and is continuing, are reported. Each test was conducted under measured meteorological conditions and over prepared sampling and grazing courses. Two tests were made over open-range type vegetation, two over irrigated pastures, and one over snow-covered ground. Two tests were conducted under lapse conditions, two under inversion conditions, and one under neutral conditions. In each case, known quantities of elemental $^{131}I_2$ were released. Relationships determined included air-grass ratios (deposition velocities) which ranged from 0.1 to 1.0 cm/sec; effective half life of ^{131}I on grass of 3.5 days and 5.5 days; the time of peak activity in milk at two days following a release; milk-grass ratio (C/1 : C/g); total ^{131}I secreted in milk by cows to that ingested by cows; adult human thyroid uptake fraction (ingestion); adult human thyroid uptake fraction (inhalation); and based on a breathing rate of 20 m^3/24 hours, the ratio between infinity mills ingestion dose and infinity inhalation dose for a single release was calculated. Data, descriptions of methods, and calculations are reported. Discussions of resuspension factors and particle sizes and behavior are also included. (auth)

18942 (N–65–17115) RADIATION MEASUREMENTS ON THE NINTH MERCURY-ATLAS MISSION (MA-9). Warren, Carlos S.; Baker, Benny R. (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). Feb. 1965. 30p. (NASA-TN-D-2608). CFSTI $2.00 cy, $0.50 mn.

Measurements were taken during the MA-9 mission to establish the radiation received both inside and outside the spacecraft. The body dosage measured on the astronaut was measured by four film badges worn on the body and inside the helmet. Radiation levels within the spacecraft were measured by a nuclear emulsion pack placed behind the instrument panel and by an ionization chamber attached to the inside of the egress hatch cover. The exterior environment measurements were made by Geiger tubes mounted on the vehicle retrorocket package. Dose measurements on the film badges worn by the astronaut show that less than 12 to 14 mR, gamma equivalent body surface dose, was received from electrons and/or gamma rays. The exterior environment measurements recorded the decay of Starfish electrons to a level between 10% and 20% of the July 1962 value. This amount is considered safe at Mercury altitudes, even for extended missions. (STAR)

18943 (N–65–21724) RADIATION EXPOSURE IN SOLAR PARTICLE BEAMS BEHIND VERY LOW SHIELDING. Schaefer, Hermann J. (Naval School of Aviation Medicine, Pensacola, Fla.). Feb. 19, 1965. 14p. (NASA-CR–62198; NSAM–914). CFSTI $1.00 cy, $0.50 mn.

Outside the vehicle the astronaut is protected from radiation merely by his space suit with a shielding equivalent of about 0.1 g/cm^2. Evaluations based on a spectral model for a solar particle beam suggested by Weir and Brown

show that the skin dose for such low shielding is due predominantly to the alpha component of the flare beam. Sixty-five percent of this alpha skin dose is produced at a high LET corresponding to a QF of 6 and an RBE of 3. The alpha dose itself, as well as QF and RBE, drops much more steeply with increasing depth in tissue than the proton dose. Analysis of the thickness distribution of a space suit due to the structural inhomogeneities shows that substituting the mean for the actual distribution introduces an error of only 2% in the surface tissue dose behind the suit materials. The findings indicate that a correct assessment of exposure in solar particle beams behind low shielding requires LET sensors in addition to instrumentation for measuring total rad doses. (auth)

18944 (NYO-3450-1, pp 213-15) CONCENTRATIONS OF COMMON LEAD IN GREENLAND SNOWS. Murozumi, M. (California Inst. of Tech., Pasadena. Div. of Geological Sciences); Chow, T. J. (Scripps Institution of Oceanography, La Jolla, Calif.); Patterson, C. (California Inst. of Tech., Pasadena. Div. of Geological Sciences).

The hypothesis that the concentration of lead in fossil precipitation, or preserved snow, should increase abruptly during the last three decades was tested by collecting snow at 10-year intervals in the Greenland snow-pack down to depths dated at about 1900. A very large increase in the lead content of recent snow over that which fell 6 decades ago in the region of the North Pole was found. The difference cannot be accounted for as originating from different amounts of silicate dusts. The data suggests that lead smelter fume might be observed as a marker occurring in post-industrial-revolution snows. (P.C.H.)

18945 (ORNL-NSIC-14) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE - 4. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 215p. Dep. ORNL Free.

Approximately 800 references on nuclear safety are given to reports, journals, books, and patents published during 1964 and 1965. Author and subject indexes are included. (P.C.H.)

18946 (ORNL-TM-1428) SHELTER FURNISHINGS FOR EFFICIENT LIVING SPACE. Kearny, Cresson H. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 25p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

To increase the useful space in a given shelter, new and improved designs of hammocks, pallets, chairs, bunks, and benches were made and partially tested. The most promising models are described, together with their design criteria, advantages, and disadvantages. By using shelter furnishings such as bridleless hammocks, floor pallets, and suspended bunks, benches, and chairs, it may be practical to shelter people satisfactorily with as little as six square feet per person in 8-ft-diam, dry cylindrical shelters (measured at the midplane), and with as little as five square feet of floor space per person in dry rectangular shelters with 8-ft ceilings. With hot-bunk systems utilizing hinged wall bunks and folding benches in single-purpose shelters, as little as four square feet per person may prove practical for a short period. The promise of much lower shelter costs by providing more efficient shelter furnishings in conjunction with increased ventilation indicates the need for realistic testing with average U. S. citizens of the concepts described in this report. (auth)

18947 (RFP-343) DRY BOX GLOVE TESTING AND EVALUATION. Giebel, R. E.; Riegel, R. L. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). [nd]. Contract AT(29-1)-1106. 3p. (CONF-631112-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Integrated Contractors Materials Meeting, Livermore, Calif.

Studies were made to determine if installations are testing glove boxes or by what criteria they are buying them. Testing procedures developed by Rocky Flats are presented in an attempt to establish a standardized testing procedure and standardized dry box glove specifications. (P.C.H.)

18948 (RFP-720) PLUTONIUM MANAGEMENT AT ROCKY FLATS. Byrne, J. T. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Feb. 11, 1966. Contract AT(29-1)-1106. 21p. (CONF-660308-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society, Plutonium Information Meeting, Washington, D. C.

Major technical considerations in plutonium materials management are discussed. Information is based upon practices developed and evaluated during nearly fifteen years of experience in large-scale plutonium chemical, metallurgical, and fabrication operations at the USAEC's Rocky Flats Plant. Particular emphasis is placed upon the problem of containment and on means of coping with loss of containment situations. Recent work on handling and measurement of plutonium shipments is summarized. Effective methods for plutonium handling and control during processing are described, and current problems in plutonium materials management are identified. (auth)

18949 (SC-DC-66-1369) AEROSPACE NUCLEAR SAFETY. Blake, V. E. Jr. (Sandia Corp., Albuquerque, N. Mex.). Mar. 18, 1966. Contract AT(29-1)-789. 11p. (CONF-660305-15). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society Topical Meeting, Augusta, Ga.

The development of radioisotope and reactor power sources for use in spacecraft is reviewed with emphasis on potential hazards and safety measures. The first space atomic power source (SNAP-3), demonstrated in 1959, used ^{210}Po as fuel, weighed 4 lb, and produced about 2.5 watts of power in 90 days, was followed by a 1961 version fueled with ^{238}Pu. In 1965 the first reactor power supply, SNAP-10A, was placed in orbit around the earth. This unit produced in excess of 500 watts of electrical power for a period of 43 days until shutdown. (C.H.)

18950 (UH-235P5-1, pp 26-38) DOSIMETRY STUDIES. CALIBRATION OF HAWAII RESEARCH IRRADIATOR (MARK IV). Upadhya, Mahesh D.; Ohinata, Kiichi (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture).

The central chamber and the five 3-inch wet tubes in the Hawaii Research Irradiator at the University of Hawaii were calibrated. The dose distribution patterns for the respective containers filled with air are presented. (H.G.D.)

18951 SIGNIFICANCE OF R, RAD, REM, AND RELATED UNITS. Williams, Marvin M. D. (Mayo Clinic and Mayo Foundation, Rochester, Minn.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 794-802 (Mar. 1966).

Definitions of units and quantities of roentgen rays adopted in 1962 by the International Commission on Radiological Units and Measurements are discussed. Emphasis is placed on the difference between measurements of exposure and dose. It is pointed out that biologic response to irradiation may be expected to have some correlation with dose, but frequently may have no correlation with exposure. (H.G.D.)

18952 DOSIMETRY AT INTERFACES FOR HIGH ENERGY X AND GAMMA RAYS. Dutreix, J.; Bernard, M. (Institut G. Roussy, Villejuif, France. Centre d'Arsonval, Limoges, France). Brit. J. Radiol., 39: 205-10(Mar. 1966).

For the γ rays of ^{60}Co the absorbed dose in water behind a wall of material with a higher Z than water is less than the dose within the water at electronic equilibrium (unless Z is more than 70); when the water is in front of the wall, the dose in the vicinity of the interface is higher than within the water. For x rays of 10 to 20 Mv there is always an over-dosage in the vicinity of the interface, whatever the direction of the radiation. In radiotherapy these results find application in all situations in which some material with a high atomic number is in contact with the tissues, within them, or even is in air at some distance from them. One conclusion is that it would be logical in telecobalt therapy to use a metal of intermediate Z (steel, for example) for the panel of the treatment couch. (H.G.D.)

18953 SOME EXPERIMENTS RELATING TO DOSE IN A MODEL OF TRABECULAR BONE. Ellis, R. E. (Middlesex Hospital, London). Brit. J. Radiol., 39: 211-15 (Mar. 1966).

An experimental model of the bone matrix was used to measure the increase in marrow dose due to the photo electrons released from the trabecular bone. Sintered glass discs having a range of pore sizes were irradiated while containing ferrous sulfate solution as a dosimeter. The increase in dose compared with the dose to free ferrous sulfate solution exposed simultaneously was determined for six discs at five radiation qualities. The experimental results were compared with the theoretical calculations of other workers. (auth)

18954 A REVIEW OF THE THEORETICAL AND EXPERIMENTAL METHODS OF DETERMINING RADIATION DOSE IN BONE. Spiers, F. W. (Univ. of Leeds, Eng.). Brit. J. Radiol., 39: 216-21(Mar. 1966).

Various methods of calculating the dose within bone and near bone surfaces are reviewed. Plane, cylindrical and spherical models irradiated by x rays and by α and β particles are considered. The problem of dose determination in trabecular bone is also considered and some results given for x rays and for $^{90}Sr-^{90}Y$ β-irradiation. The theoretical results are compared with the available experimental findings obtained with ionization chamber, scintillator, and other techniques. Where comparison can be made, the experimental results agree reasonably with theoretical calculations. (auth)

18955 DETERMINING THE TOTAL, ABSORBED DOSE DURING INTERNAL IRRADIATION. Obaturov, G. M.; Zabavin, A. K. Gig. Sanit., No. 10, 71-8(Oct. 1965). (In Russian).

On the assumptions that the change in the number of radioactive nuclei (N) in a critical organ is proportional to N and that the dose rate in the critical organ is proportional to the activity in the organ, it is possible to derive the following expression for the dose: $D = [P_0\ \bar{c}\ t\ (1-[\exp \lambda_{eff}\ t'\ \alpha)]/[1-\exp \lambda_{eff}\ \tau_{50}]$ MPC (rads). Here P_0 is the maximum permissible dose rate for a critical organ, equal to 0.0026, 0.0078 and 0.0155 rads/hr for critical organs of the 1st, 2nd and 3rd group respectively. The average concentration of radioactive aerosol in curies/liter is given by $\bar{c}$; τ is the residence time of a man in the contaminated atmosphere; λ_{eff} is the effective decay constant due to radioactive decay and biological elimination; τ_{50} is the maximum possible working time equal to 50 years; $t' = t + \tau/2$, where t is the time elapsed after the man emerges from the contaminated atmosphere. MPC is the maximum permissible concentration of radioactive isotopes in air (in curies/l). The value of α is a function of λ_{eff}, τ and t. If $t_{eff} = 0.693/\lambda_{eff} < 5$ days and $t > 30$ days, the above expression can be simplified as follows: $D = P_0\ \bar{c}\ \tau/MPC = \bar{c}\ \tau\ B$ (rads). Values of B are tabulated for ^{24}Na, ^{56}Mn, ^{105}Ru, ^{133}I, ^{132}I, and ^{239}Np. For longer-lived isotopes such as ^{90}Sr, ^{131}I, ^{210}Po, ^{226}Ra, ^{239}Pu, and ^{240}Pu, values of B are also tabulated for a 50 year period of time. Coefficients were calculated and tabulated to determine the values of B for periods of one week, a month, three months and one year. These tabulated values of B are multiplied by the product $\bar{c}\ \tau$ (measured experimentally) in order to determine the internal radiation dose. A number of practical examples of calculating the dose to various internal organs are presented. (TTT)

18956 THE WORK OF DISTRICT RADON LABORATORIES IN SOCHI. Gusarov, I. I.; Lev, Kh. O. (Central Inst. of Physiotherapy, Moscow). Gig. Sanit., No. 10, 91-4 (Oct. 1965). (In Russian).

The layout of a central supply laboratory specializing in the preparation of a concentrated, aqueous solution of radon is described. The dose readings vary from 5 to 60 mR/hr. With a gas diffuser containing 30 mg of radium, it is estimated that the daily dose is 9 mR for performing all operations. A total of 300 portions of radon solution are prepared each day with the consumption of 2 to 3 mC of radon. The weekly dose to all personnel is 30 to 50 mR with a permissible dose of 100 mR per week. The air flow at the hood face is ~0.6 mC/sec which gives 8 air changes per hour. (TTT).

18957 RADIOACTIVE CONTAMINATION AT THE WORKING POINT OF GAMMA-APPARATUS AND ITS HYGIENIC ASSESSMENT. Vainberg, M. Sh.; Terman, A. V. (Central Medical Inst. for Graduate Work, Moscow). Gig. Sanit., No. 10, 113-15(Oct. 1965). (In Russian).

Two ^{60}Co sources were dismantled, and the inner surfaces of the containers were smeared for radioactivity. The average values of the contamination were found to be 2.49×10^7 and 5.77×10^7 disintegrations $(150\ cm^2)^{-1}\ min^{-1}$, which correspond to total activities of 113 and 262 μC for the two sources. The distribution of activity along the channel was highest for the storage position with a secondary maximum for the irradiation position. It should be noted that no radioactivity was detected on the external surfaces of the sources. (TCO)

18958 CALCULATION OF LOCAL ENERGY DEPOSITION DUE TO ELECTRON CAPTURE AND INTERNAL CONVERSION. Smith, Edward M. (New York Hospital, N. Y.); Harris, C. Craig; Rohrer, Robert H. J. Nucl. Med., 7: 23-31(Jan. 1966). (ORNL-P-1597).

Tabulated values of the average electron-type energy emitted per disintegration, the photon yields, and the specific gamma-ray constant are presented for radionuclides of current interest in nuclear medicine: ^{131}Cs, ^{51}Cr, ^{57}Co, ^{197}Hg, ^{203}Hg, ^{125}I, ^{75}Se, ^{85}Sr, ^{87m}Sr, and ^{99m}Tc. The method used for calculating these parameters directly from nuclear decay scheme data is described. (auth)

18959 CONTROL OF COMMERCIAL AIRCRAFT WITH RESPECT TO RADIOACTIVE CONTAMINATION. Nagel, G. (Deutsche Lufthansa AG, Hamburg). Luftfahrttech., Raumfahrttech., 11: 288-302(Nov. 1965). (In German).

Results of contamination measurements on the surface of aircraft recorded from 1962 to the middle of 1965 are reported. Immediate analysis was carried out; in cases of high levels of radioactivity (1963) it is useful to carry out further studies of the radioactive decay. Analysis of the β decay energy spectrum over a period of 48 months was used to select a method of measurement of fallout. Ten positions on the aircraft were chosen as control points and the results averaged. Data for several craft (as a group or singly) used on north Atlantic and polar flights, or on south Atlantic, near and far East, and African flights, are graphed. For the northern flights, data before April 1963 averaged below 20 imp/sec (52 imp/sec = $1 \times 10^{-3}\ \mu C/cm^2$); a max of 38 imp/sec was reached in June 1963; after Oct. 1964, data averaged below 10 imp/sec. For southern flights, data before September 1962 and after October 1964 averaged below 5 imp/sec; the maximum value, 12 imp/sec, was attained in June 1963. A discussion of protection control methods is included. (BBB)

18960 EXPERIMENTAL DETERMINATION OF THE ABSORBED DOSE FROM ALPHA-EMITTERS IN CONTACT MEDIA. Ershov, E. B.; Karan, A. A.; Spirin, V. D.; Shamov, V. P. (Research Inst. of Radiation Protection, Leningrad). Med. Radiol., 10: 10-14(Oct. 1965). (In Russian).

A method for determining absorbed dose using the energy distribution of alpha emissions passing from the thick layer of a contact medium is presented. (H.G.D.)

18961 DETERMINATION OF NATURAL RADIOACTIVITY IN THE HUMAN BODY. Sivintsev, Yu. V.; Arutinov, O. M.; Kanareikin, V. A. Med. Radiol., 10: No. 11, 66-71(Nov. 1965). (In Russian).

Whole-body measurements of ^{40}K and ^{137}Cs were made on 114 persons between September 1962 and August 1963. Mean potassium content was 1.98 ± 0.08 gK/kg body weight in males and 1.53 ± 0.4 gK/kg body weight in females. The specific activity of ^{137}Cs rose from 20 to 50 pC/gK at the end of 1962 up to 100 to 150 pC/gK in August 1963. The sharp rise in ^{137}Cs values was attributed to pollution of the biosphere by nuclear explosions. (H.G.D.)

18962 THYROID DOSE OF ITALIAN CHILDREN AFTER INGESTION OF ^{131}I FROM FALLOUT. Giorcelli, F. G.; Cigna, A. A. (Comitato Nazionale per l'Energia

Nucleare, Casaccia, Italy). Minerva Nucl., 9: 325-7(Sept.-Oct. 1965). (In Italian).

The mean intake and thyroid dose due to ingestion of ^{131}I contaminated milk by Italian children in the period October 1961 to February 1963 were calculated. (auth)

18963 MEDICAL PROTECTION AND CONTROL OF MEMBERS OF THE C.A.M.E.N. STAFF EXPOSED TO IONIZING RADIATIONS. Pulcinelli, Mario (Centre Applicazioni Militari Energia Nucleare, Pisa, Italy). Minerva Nucl., 9: 327-32(Sept.-Oct. 1965). (In Italian).

The Centre for Military Applications of Nuclear Energy in San Piero a Grado is briefly described, stressing the importance of the specialized infirmary existing in the Centre. The following duties of the infirmary are stressed: medical control, and training of specialized personnel etc. The various activities of the infirmary are described in greater detail: preventive work, roentgenologic aid, conventional aid, medico-legal duties, scientific activities, military activities. The various departments of the specialized infirmary are illustrated. (auth)

18964 UTILIZATION OF HIGHER PLANTS AS INDICATORS IN STUDYING THE EFFECT OF ORBITAL SPACEFLIGHT FACTORS ON THE LIVING CELL. Delone, N. L. Probl. Kosm. Biol., 4: 304-7(1965). (In Russian).

The use of biodosimeters for space-flight studies is discussed. The dried seeds of a number of higher plants, microspores of Tradescantia paludosa, tissue culture of horsebean and Haploppapus gracilis roots, onion bulbs, and pollen of corn, pine, and Trillium are evaluated for space research. (H.G.D.)

18965 ^{210}Po IN TOBACCO, CIGARETTE SMOKE, AND SELECTED HUMAN ORGANS. Ferri, Esther S.; Baratta, Edmond J. (Public Health Service, Winchester, Mass.). Public Health Rep., 81: 121-7(Feb. 1966).

A study was conducted at the Northeastern Radiological Health Laboratory of the Public Health Service to determine the levels of ^{210}Po in several brands of cigarettes. Levels of ^{210}Pb and ^{226}Ra were also measured to determine whether the ^{210}Po was in equilibrium with these precursors or was present independently. Samples of human organs were also analyzed for ^{210}Po content to determine whether a difference could be detected in the concentration of the radionuclide between smokers and nonsmokers. Polonium-210 and associated radionuclides were found to be present in tobacco. Considerable smaller quantities of ^{226}Ra were also found. These indicated that ^{210}Pb is deposited in the tobacco independently of ^{226}Ra and its daughter ^{210}Bi. For the various brands tested, the activities of ^{210}Po in the total cigarette were of about the same level. Values for ^{210}Po in inhaled smoke ranged from 11 to 35.7% of that in the total cigarette. Average dosages to the lungs of a person smoking two packages of cigarettes per day were calculated to be far below the maximum permissible concentration for air per person in the general population. Tests indicated higher levels of ^{210}Po in the organs of smokers than in those of nonsmokers. (TCO)

18966 THE RADIATION CONTROL PROGRAM. Blatz, Hanson (New York City Office of Radiation Control. New York Univ., New York); Heller, M. B.; Kamholz, S. M.; Lynch, D. E.; Paul, I. R.; Reich, B. S.; Smolens, M. Public Health Rep. (U. S.), 81: 57-63(Jan. 1966).

The radiation control program of the New York City Department of Health is described. The program included both the inspection of x-ray machines and the regulation of radioactive materials. (H.G.D.)

18967 FISSION PRODUCT GAMMA ACTIVITY IN SURFACE AIR—80TH MERIDIAN AND U.S. LOCATIONS, DECEMBER 1964. (Atomic Energy Commission, Washington, D. C.). Radiol. Health Data, 6: 343-50(July 1965).

Data are presented on the total γ activity in weekly ground level air samples collected at sampling stations along the 80th meridian (west) from Thule, Greenland, to Punta Arenas, Chile, during Dec. 1964. Data are included on the ^{137}Cs content in air samples collected in 1963 and 1964. (C.H.)

18968 RADIOSTRONTIUM IN CALIFORNIA MILK, JANUARY 1960 THROUGH JUNE 1963. Greenberg, Arnold E.; Cornish, Amasa C.; Uyesugi, George S.; Heslep, John M. Radiol. Health Data, 6: 367-70(July 1965).

Data are presented on the ^{90}Sr content in milk samples collected in California from Jan. 1960 through June, 1963. (C.H.)

18969 ESTIMATES OF THE CONCENTRATIONS OF ^{89}Sr, ^{90}Sr, AND ^{137}Cs IN MILK AS A FUNCTION OF TIME AFTER AN ACUTE LOCALIZED CONTAMINATING EVENT. Radiol. Health Data, 6: 383-6(July 1965).

A quantitative assessment is presented of various factors involving the radioactive contamination of pastures and milk subsequent to an acute contaminating event. Certain assumptions are made, including that ^{89}Sr, ^{90}Sr, and ^{137}Cs are the radionuclides released to the environment. (C.H.)

18970 EFFECT OF VARIETY ON THE ACCUMULATION OF ^{90}Sr IN WHEATS AND THEIR MILLED PRODUCTS. Anderson, R. A.; Pfeifer, V. F. (Agricultural Research Service, Peoria, Ill.). Radiol. Health Data, 6: 438-40(Aug. 1965).

A comparison was made of differences in ^{90}Sr uptake by 16 varieties of wheat planted in identical soil and grown under identical conditions and under different conditions. A comparison was also made of milled products from varieties grown under identical conditions. Nearly equal amounts of ^{90}Sr were present in the flour from all varieties but the outer layer used for bran and shorts varied in ^{90}Sr content by as much as 50%. Results indicate that specific wheat varieties can be grown to minimize uptake of ^{90}Sr from fallout and absorption from soil. (C.H.)

18971 MEASUREMENT OF ^{131}I IN BOVINE THYROIDS. Falter, Kenneth H. (Public Health Service, Washington, D. C.); Murray, George Radiol. Health Data, 6: 451-5 (Aug. 1965).

Bovine thyroids are more sensitive than fluid milk as an indicator of environmental ^{131}I content. Results are reported from the analysis of 1445 samples collected during the last half of 1963 from lactating and non-lactating cows throughout the U. S. The problem of ^{226}Ra contamination of bovine thyroids and effects on results of analysis for ^{131}I is discussed. (C.H.)

18972 RADIOLOGICAL HEALTH DATA. Volume 6, Number 11. Public Health Service, Washington, D. C., Nov. 1965. 71p. GPO $0.50.

Data are presented on the radioactivity in samples of air, milk and other foods, surface waters, and drinking water collected throughout North America during the first half of 1965. Data are included on the content of fallout radionuclides in milk, total diet, and human bone samples collected during 1963 and 1964. Environmental levels of radioactivity at Mound Laboratory and Lawrence Radiation Laboratory from July through Dec. 1964, and at Los Alamos Scientific Laboratory during the calendar year 1964 are reported. Seismic signals recorded on Oct. 8, 1965, indicated a disturbance in the Soviet nuclear testing area in the Semipalatinsk region equivalent to a low-intermediate yield nuclear explosion. The U. S. announced the detonation of an 80-kiloton thermonuclear device about one-half mile underground on Amchitka Island, Alaska, on Oct. 29, 1965. (C.H.)

For abstracts of individual sections see: 18917, 18973, and 18974.

18973 ^{137}Cs IN FRESHWATER FISH: HUMAN CONSUMPTION AND BODY BURDEN CONSIDERATIONS. Gustafson, P. F. (Argonne National Lab., Ill.). Radiol. Health Data, 6: 626-9(Nov. 1965).

Evidence of the importance of freshwater fish as a dietary source of ^{137}Cs is reviewed. Results are presented from measurements of the content of ^{137}Cs and K in freshwater and ocean fish purchased in food markets in the Chicago area from Jan. to Aug. 1965 and the ^{137}Cs, K, and $^{137}Cs/K$ ratio in the adult diet in Chicago during April 1965. Data are included from calculations of the ^{137}Cs

body burden that could be attained by people subsisting on a diet containing large amounts of fish. (C.H.)

18974 RADIOACTIVE CERAMIC GLAZES. Menczer, Leonard F. (Hartford Health Dept., Conn.). Radiol. Health Data, 6: 656-9(Nov. 1965).

The use of uranium compounds to produce pigmented glazes for ceramicware was common practice in the U. S. before 1944. The colors produced by using uranium ranged from brilliant orange-red to lemon-yellow. Gamma and beta measurements made at the surfaces of specific types of glazed ceramicware were compared with measurements reported by others. The radioactivity of ceramic glazes produced before 1944 were compared with those produced after 1949 and estimates were made of the radiation exposure to the hands of persons handling the ceramicware. It was concluded that the amount of radiation exposure contributed by the glazed ceramicware containing uranium is barely detectable with sensitive measuring instruments and presents no health hazard. (C.H.)

18975 DOSIMETRY OF COLLOIDAL RADIO-GOLD BY MEANS OF NEUTRON ACTIVATION ANALYSIS WITH A LOW POWER REACTOR. Laconi, A.; Brancato, G.; Melfi, F. Radiol. Med., 51: 1112-22(Oct. 1965). (In Italian).

A method for radiogold dosimetry in guinea pig organs using neutron activation by a low power reactor (the AGN 201 Costanza) is described. Advantages of the method are reliability and short performance time. (H.G.D.)

18976 MONITORING OF THE RADIOACTIVITY OF FOODS. Schriftenreihe Bundesmin Wiss. Forsch., Strahlenschutz (Munich), 26: 1-218(1965). (In German).

The 23 papers presented before two sessions of the Subcommittee on Radioactivity Monitoring of Foods and Other Biological Materials are compiled. The topics discussed were: systematic sampling in contamination studies on food; organization of monitoring systems for food contamination; radioactivity of cistern and surface waters of Silesia-Holstein; radiation burden from uptake by foods of radioisotopes released by nuclear explosions; radiochemical determination of ^{137}Cs, determination of ^{137}Cs in food ash; behavior of Cs and K compounds at increased temperatures during ashing of foods; preparation of measurement samples; error statistics in the counting of nuclear particles; measurements in whole-body counter; quantitative γ spectroscopy; Sr determination using x-ray fluorescence; rapid methods of measurement; selection of sampling sites and sampling sequences; sampling program for monitoring of food; monitoring network in the USA; error possibilities in contamination research; radioactivity in foods in 1962 and estimation of radiation burden received by population; radioactivity monitoring of food imports; removal of radioactive contaminants from food using milk as an example; decontamination of milk with wheying methods; the permissible uptake of radioactive materials in men, and desirable supplements to present monitoring programs. (J.S.R.)

18977 THE DOSIMETRY OF PHANTOMS LESS THAN 25 cm THICK (PRELIMINARY RESULTS X-RAY DEVICES, ^{137}Cs, AND ^{60}Co). Legare, Jean-Marc (Univ. of Montreal). Strahlentherapie, 129: 200-6(Feb. 1966). (In French).

The effects of energy, field size, tissue thickness and depth on phantom dose were measured for single and opposing fields. Due to a new method, the true backscatter factor can be determined for energies of 0.5 to 3 Mev. The back-scatter factor as a function of angle of incidence can also be measured with the set-up. A practical suggestion is given to overcome the loss of cobalt 60 skin-sparing through treatment couch or localizing mold. (auth)

18978 ON THE INFLUENCE OF THE ABSORPTION OF X AND GAMMA RADIATION IN BONES ON THE DOSE DISTRIBUTION IN INHOMOGENEOUS MEDIA. Lobodziec, Wlodzimierz; Lubas, Barbara; Neumann, Henryk (Onkologische Institut, Gliwice, Poland). Strahlentherapie, 129: 220-5(Feb. 1966). (In German).

Experimentally, the bearing of geometrical values of the bone (thickness, diameter, and position within the medium radiated) upon dose distribution at points underneath the bone, was investigated. Moreover, the influence of the medium surrounding the bone on absorption of x- and γ-rays was investigated. The experiments were carried out within an energy range of 47 to 120 kev for x rays and for the γ radiation of cobalt 60. (auth)

18979 ENTGIFTUNGS- UND ENTAKTIVIERUNGS-GERAETE. (Decontamination and Deactivation Instruments). Blumenstein, Werner. Berlin, Deutscher Militaerverlag, 1965. 226p.

A description is given of specific devices used in decontamination and deactivation work. The concepts of decontamination, deactivation, and disinfection are described. The instruments and installations used for the decontamination and deactivation of weapons, instruments, and vehicles, instruments used for land decontamination, instruments for clothing decontamination, disinfection devices, instruments for sanitary processing, temporary decontamination devices, auxiliary instrumentation for deactivation and decontamination, and commercial devices usable for decontamination work are considered. (J.S.R.)

18980 FEDERAL RADIATION COUNCIL PROTECTIVE ACTION GUIDES. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH, DEVELOPMENT, AND RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-NINTH CONGRESS, FIRST SESSION, JUNE 29 AND 30, 1965. Washington, D. C., Joint Committee on Atomic Energy, 1965. 702p. GPO.

The Subcommittee on Research, Development, and Radiation of the Joint Committee on Atomic Energy, Eighty-ninth Congress of the United States held hearings on June 29 and 30, 1965, on the Federal Radiation Council's Protective Action Guides, as set forth in FRC Reports Nos. 5 and 7. Protective Action Guide was defined as the projected absorbed radiation dose to individuals in the general population which would warrant protective action following a contaminating event. Because of the relationship of these guides to fallout, additional information was presented that updated information that had accrued since the 1963 hearings regarding levels of fallout nuclides in the atmosphere, on the ground, and in food chains, with emphasis on ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr and the special case of contamination of arctic ecology by ^{137}Cs and ^{90}Sr. Actions appropriate to situations involving contamination of the environment by these radionuclides were discussed with emphasis on an acute contaminating event that may result from an accident rather than from a planned program, limitation of the hazard by controls exercised at the source, and means for reduction of a potential hazard after it has been created. Statements of witnessess, additional material inserted in the record, and a subject index are included. (C.H.)

18981 SURVEY OF MEDICAL USERS OF RADIUM IN PENNSYLVANIA. Gerusky, Thomas M. (Pennsylvania Dept. of Health, Harrisburg). 8p. (CONF-651060-1). ORAU. Gmelin, AED-CONF-65-318-1.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Medically used radium sources were surveyed by the Radiological Health Section of the Pennsylvania Department of Health. The radiation survey consisted of monitoring the radium storage area with an ionization chamber survey meter. Gamma levels were determined at three points: at contact, at one foot distance, and at one yard distance from the storage container. The type and thickness of the storage container were also noted. All adjacent uncontrolled areas were monitored. The most significant finding of the survey was the lack of annual leak testing. Inadequate storage of radium sources and improper labeling were also frequently found. It was concluded that: little information has been made available to the medical profession concerning the safe handling and use of radium sources; the more urgent problem areas are in private offices; increased educational and communi-

cations efforts are indicated both on the part of the regulatory agent and on the part of the radium source suppliers; and enforcement of existing regulations is needed. (H.G.D.)

18982 RADIUM MANAGEMENT AT THE COUNTY LEVEL. Manning, Justice A. (Alabama Health Dept., Birmingham). 15p. (CONF-651060-3). ORAU. Gmelin, AED-CONF-65-318-3.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Radiation control was extended in Jefferson County, Alabama, to include radium sources. Response to the pilot project was enthusiastic since radium sources were carefully checked for contamination. Surveys of Ra sources within the county showed that contamination was common to all. Suggestions were made at each facility surveyed for decontamination procedures and methods of safer operation. It was shown that local, state, and federal government agencies can operate together for the efficient control of radioactive sources. A new method for leak-testing is described. (H.G.D.)

18983 PREDICTION OF ^{131}I IN MILK FOR PROTECTIVE ACTION PLANNING. Stigall, G. E.; Leary, A. G. (Public Health Service, Rockville, Md.). 23p. (CONF-651060-4). ORAU. Gmelin, AED-CONF-65-318-4.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Mathematical equations were developed for use in predicting the atmospheric dispersion, ground deposition, and concentration in milk of ^{131}I that might be released to the environment by nuclear accidents. Calculations of atmospheric dispersion and ground deposition of ^{131}I utilizing the work of Sutton and Chamberlain are presented first. Subsequent discussion deals with ground deposition, the concentration of ^{131}I in milk, and the resulting thyroid dose to a 1-year-old receptor. Use of mathematical equations to evaluate actual emergency surveillance techniques would point out some present inadequacies in predetermining a proper response to an accident at a nuclear facility and the pitfalls of using ratios in predicting estimated thyroid doses to people. (TCO)

18984 RADIUM IN MILITARY SURPLUS COMMODITIES. Halperin, Jerome A. (Public Health Service, Rockville, Md.); Heslep, John M. 18p. (CONF-651060-6). ORAU. Gmelin, AED-CONF-65-318-7.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Results of a pilot study undertaken to identify the typical kinds of radioactive military surplus articles commercially available in California are reported. The problem appeared to be mainly confined to aircraft panel instruments, switches, knobs and buttons, electron tubes, dials, gauges and meters, portable radio transmitters, ships clocks, and pocket compasses. Regulations for disposal of the items and for radium control are discussed, and measures to alleviate the problem are considered. (H.G.D.)

18985 AN EFFECTIVE MEASURE FOR MODERATING RADIONUCLIDE LEVELS IN MILK. Hansen, Warren G. (St. Louis Coll. of Pharmacy); Black, Wayne E. 9p. (CONF-651060-2). ORAU. Gmelin, AED-CONF-65-318-2.

From American Public Health Association, 93rd Annual Meeting, Chicago.

Various controlled experiments are described for studying contamination by ^{90}Sr and ^{131}I of milk produced on the St. Louis and New Orleans milksheds. Good land management and fertilization of pastures was found to reduce the ^{90}Sr and ^{131}I content in milk in proportion to the increase in forage crop production. (B.L.M.)

18986 RADIATION PROTECTIVE APRON. Bushnell, Francis L. U. S. Patent 3,233,248. Feb. 8, 1966. Filed Apr. 19, 1963.

A protective apron for radiation shielding is described that is of minimum size and is adapted to cover the reproductive organs and many of the body glands. The apron is particularly designed for dental roentgenography. The apron comprises a body member including a tapered lower portion adapted to fit between the thighs of the patient, a main portion above the tapered portion and adapted to cover at least a part of the torso of the patient, and a pair of shoulder straps extending upwardly from the upper edge and opposite sides of the main portion to extend over the shoulders of the patient. A cross strap extends between the shoulder straps and holds the body member in the desired relation to the seated patient. A bib is adjustably attachable to the shoulder straps at various positions to adjust the effective length of the body portion. The tapered lower portion and main portion of the body member are formed of radiation absorptive material. (B.L.M.)

18987 GLOVE CHANGING APPARATUS AND METHOD. Hayne, R. E.; Owen, J. B. (to U. S. Atomic Energy Commission). U. S. Patent 3,237,821. Mar. 1, 1966.

A method and appratus are described for rapidly replacing a glove on a glove box aperture a virtually unlimited number of times without subjecting the contents of the box to possible contamination from exterior sources or, conversely, without releasing contaminated products confined within the box. The apparatus effectuating the method consists of a glove-changing ring, which cooperates with the box and the glove to be placed thereon. (AEC)

INSTRUMENTATION

General

Refer also to abstract 20185.

18988 (BNL-929, pp 58-66) INSTRUMENTATION. (Brookhaven National Lab., Upton, N. Y.).

Activities associated with development and procurement of instruments and systems for research projects are summarized. Major projects during the year include development and production of digitized discharge planes for hodoscope experiments and design of computer systems to operate HFBR spectrometers. (J.R.D.)

18989 (EGG-1183-1165) FAST RESPONSE MICROMICROAMMETER. Hendricks, M. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Nov. 1, 1965. Contract AT(29-1)-1183. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An amplifier capable of observing currents in the microampere to picoampere range with certain advantages over amplifiers used in the past is described in terms of its design and performance. (M.O.W.)

18990 (LA-3451) BURN INVESTIGATIONS OF SOME COAXIAL CABLES. Jackson, F. M.; Stapleton, R. E. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 27, 1965. Contract W-7405-eng-36. 36p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The burning of individual cables and of groups of cables was investigated. The results indicate that a conflagration could occur if a group of coaxial cables were ignited externally. (D.C.W.)

18991 (LNF-65/43) IL MISURATORE DI COORDINATE R.M.C.-II. (Coordinate Meter R.M.C.-II). Note No. 295. DeGiorgi, M.; Schiavon, G.; Soso, F. (Laboratorio Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 14, 1965. 20p. Dep. mn.

A semi-automatic system that was developed for the scanning of photographs of oscillographic traces is described. (D.C.W.)

18992 (LNF-65/46) CONVERTITORE TEMPO AMPIEZZA. (Time Amplitude Converter). Note No. 298. Dardini, C.; Villalba, A.; Visentin, R. (Laboratoire Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Dec. 2, 1965. 19p. Dep. mn.

A time-amplitude converter that uses semiconductor elements is described. An analysis of the linear wave form is summarized, together with some tests of the performance of the converter. (D.C.W.)

18993 (N-65-24356) INVESTIGATION OF MICROBIAL CONTAMINATION INSIDE IRRADIATED AND HEATED ELECTRONIC COMPONENTS. Portner, Dorothy M. (Army Biological Labs., Frederick, Md. Physical Defense Div.). Apr. 20, 1965. 5p. (NASA-CR-62873). CFSTI $1.00 cy, $0.50 mn.

Electronic components, which had been irradiated to various doses or had been exposed to dry heat were tested for internal microbial contamination. In the testing procedure nine untreated components were used as controls. Of these nine components, only one was contaminated. Five of twenty-two irradiated components were contaminated, and none of six dry-heat-treated components contained bacterial spores. (STAR)

18994 (SGAE-PH-31/1965) ANWENDUNG DER RADIOAKTIVEN TRACERTECHNIK IM HOCHVAKUUM ZUR KONSTRUKTION EINES MASSENSEPARATORKOLLEKTORS FUER XENON. (Application of Radioactive Tracer Technique in High Vacuum for Construction of Mass Separator Collectors for Xenon). Dobrozemsky, R.; Hechtl, E.; Viehboeck, F. P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). [1965]. 11p. Dep. mn.

A mass separator collector was designed and constructed for the collection of xenon. ^{131}Xe was used in trace amounts for the determination of xenon adsorbed on the activated charcoal and the equilibrium time. The method used is described in some detail and a description is given of the collector installation. (J.S.R.)

18995 (SGAE-PH-39/1966) UEBER EIN NEUES MAGNETLOSES DYNAMISCHES MASSENSPEKTROMETER. (On a New Magnetless Dynamic Mass Spectrometer). Higatsberger, M. J.; Ruedenauer, F.; Viehboeck, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1966. 14p.

A mass spectrometer is described in which the energy selection is made by means of parabolic particle orbits. A review is given of the mathematical treatment of such a system and specifications on the construction of the prototype. (tr-auth)

18996 (WAPD-TM-557) MO565: A PROGRAM TO SOLVE A RECTANGULAR MAGNETIC NETWORK FOR USE ON THE PHILCO-2000 COMPUTER. Guerdan, D. A. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Feb. 1966. Contract AT(11-1)-Gen-14. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

MO565 is a digital computer program to find the magnetic flux in each branch of a magnetic network consisting of a large number of branches of iron and air. The magnetomotive force driving flux in the network is not concentrated in any one branch, and the iron branches need not have the same saturation characteristic. The problem is solved by assimilating the magnetic network to an electrical network and using Kirchkoff laws of current and voltage. Several iterations are needed, and the program stops when the error is smaller than a criterion of convergence specified in the input. The network is of rectangular shape and consists of a maximum of 15 double loops plus three outside loops. (auth)

18997 STUDY OF THE RECORDING OF HIGH FREQUENCIES BY PHOTOGRAPHIC EMULSIONS. Royer, Henry (Institut d'Optique, Paris). Compt. Rend., 261: 5024-7(Dec. 8, 1965). (In French).

The production of Young fringes was utilized to determine the resolution limits of photographic plates in a region in which classical microdensitometric analysis can not be used conveniently. (tr-auth)

18998 NEW MASS SPECTROMETERS WITH 360 DEG DEFLECTION. Geerk, Jens (Institut Franco-Allemand de Recherches, Saint-Louis, France). Compt. Rend., Ser. B, 262: 479-82(Feb. 14, 1966). (In French).

A study is made of large-dispersion mass spectrometers making it possible to construct instruments for the analysis, starting from a single spectrum, of a plasma of positive and negative ions. (J.S.R.)

18999 A SIMPLE TECHNIQUE FOR ABSORPTION OF $^{14}CO_2$ AND ITS DIRECT MEASUREMENT IN LIQUID SCINTILLATION COUNTERS. Baggiolini, M. (Univ., Bern). Experientia, 21: 731-3(1965). (In German).

A novel and simple kind of $^{14}CO_2$ trap is described. It can be used directly for subsequent scintillation counting. Solutions for optimal absorption and counting efficiency are indicated. (auth)

19000 SOME PLASMA-PHYSICAL ASPECTS OF MONO- AND DUO-PLASMATRON ION SOURCES. Kistemaker, J.; Rol, P. K.; Politiek, J. (FOM-Laboratorium voor Massascheiding, Amsterdam). Nucl. Instrum. Methods, 38: 1-11(1965).

In ion source operation a quiescent plasma boundary in the exit hole as well as high gas efficiency are of vital importance in plasma physics, isotope separation and space

propulsion. The problems of the origin of the plasma vibrations in ion sources and the rise of the degree of ionization of the source gas in the plasma cap are therefore of some interest. The origin of some types of vibrations is discussed. Moreover, a simple discussion of electrostatic double layers in connection with ion source plasmas is given. According to Demirchanov's measurements they can produce a very high electron temperature and thus a high degree of ionization. Finally, some results with a monoplasmatron ion source are given. (auth)

19001 AN ION SOURCE WITH PLASMA COMPRESSION. Sevarac, I. (Inst. of Nuclear Science Boris Kidric, Belgrade). Nucl. Instrum. Methods, 38: 12-14(1965).

The characteristics and the construction of an uno-plasmatron ion source are given. The source was built as an intense ion source for the electromagnetic isotope separator in the Institute for Nuclear Sciences Belgrade. Experiments with this ion source were performed with single and double constriction, without using a magnetic field for the second constriction. In order to explain the mechanism of the discharge in a uno-plasmatron ion source some additional experiments were performed in an auxiliary gas discharge tube. In the configuration of this tube the plasma constriction was performed by decreasing the tube diameter in steps from cathode to anode. In each section of this tube, Langmuir probes were introduced for the determination of the gas discharge characteristics. (auth)

19002 THE HIGH-TEMPERATURE HOLLOW CATHODE ION SOURCE. Sidenius, G. (Princeton Univ., N. J.). Nucl. Instrum. Methods, 38: 19-22(1965). (PPAD-2137-558).

A description is given of a novel ion source for an electromagnetic isotope separator, which makes use of the hollow cathode effect. The new ion source has a very small plasma volume and a very high temperature. Over-all efficiencies as high as 40% for argon and 60% for xenon have been measured. (auth)

19003 CUT-OFF PHENOMENA IN THE MAGNETRON ION SOURCE. Tosic, D. (Inst. of Nuclear Sciences Boris Kidrich, Belgrade). Nucl. Instrum. Methods, 38: 26-8(1965).

Some aspects of the behavior of a magnetron ion source were investigated. It was found that in this configuration the anode current cut-off could occur without external magnetic field. By means of oscillographic examination of the anode current waveforms, the influence of the filament heating current on this phenomenon was studied. (auth)

19004 SOME PROPERTIES OF THE ION BEAM FROM A SOURCE OF DUOPLASMATRON TYPE. Septier, A.; Prangere, F.; Ismail, H. Gautherin, G. (Faculte des Sciences, Orsay, France). Nucl. Instrum. Methods, 38: 41-7(1965).

The width of energy spectra and the most probable energy of mercury ions extracted from a duoplasmatron increase suddenly beyond a critical value of the discharge current. At the same time, a large proportion of doubly charged ions may be found in the beam, even at very low arc voltages. The presence of oscillations in the discharge can explain these phenomena. Another experiment shows the drastic influence of the remaining magnetic stray field in front of the anode on the optical properties of the beam, when a large plasma expansion cup is used. (auth)

19005 A SOLID-STATE LOW-NOISE PREAMPLIFIER. Hansen, D. O.; Roy, N. L. (TRW Systems, Redondo Beach, Calif.). Nucl. Instrum. Methods, 40: 209-12(Mar. 1966).

A completely solid-state voltage sensitive preamplifier is described. A field effect transistor is used as the input stage. The equivalent noise charge referred to the input is 250 electrons. The input capacitance is 1 pF and is obtained by a bootstrapping technique. The input resistance is 10^{10} Ω and the frequency response is from 10 kHz to 7 MHz. The preamplifier has a voltage gain of 15 and is linear to ±2% to an output voltage of 10 v. (auth)

19006 ON TRANSFER CHARACTERISTIC OF LOGARITHMIC AMPLIFIER. Horn, L. S.; Khasanov, B. I. (All-Union Instrumentation Research Inst., Moscow). Nucl. Instrum. Methods, 40: 267-71(Mar. 1966).

The transfer characteristic of a logarithmic amplifier is treated, measuring a wide range of input currents. Input current and output voltage rise and decay curves for single-step signals are given and pulse rise and decay times calculated. (auth)

19007 GAIN CHANGES OF VALVO 56 AVP PHOTOMULTIPLIERS. Schneider, H.; Weingardt, C. (Univ., Giessen, Ger.). Nucl. Instrum. Methods, 40: 305-8(Mar. 1966). (In German).

The gain changes of Valvo 56 AVP photomultiplier tubes (PM) after counting rate changes were investigated with regard to their dependence on dynode current and temperature. The photomultipliers were combined with a NaI(Tl)-crystal. Changes of the counting rate cause a fast initial gain change, followed by a slow shift. Within 30 hr, four tubes stabilize in gain, while one tube shows a further slow drift. All changes are reversible. Magnitude and time dependence of gain changes vary with dynode current and temperature of the PM. An increase of temperature or dynode current at a high counting rate speeds up the gain changes. The gain changes may be explained by cesium atoms covering the emitter surface of the dynodes. (auth)

19008 IMPROVEMENTS APPLIED TO VERNIER CHRONOMETERS (VERNIER CHRONOTRONS). Thenard, J.; Victor, G. (Service d'Instrumentation Nucleaire, Saclay, France). Nucl. Instrum. Methods, 40: 318-24 (Mar. 1966). (In French).

The largest time interval, that can be measured by means of the vernier chronotrons working on the principle of beat between two generators of slightly different periods, is limited by the period of the slower generator. The improvements brought to the vernier chronotrons system are presented, which permit the use of this device in order to define a very great number of channels without impairing their stability and differential linearity; indeed, the method used leads to measure in a homogeneous way the time intervals larger than one period. In order to verify the basic principle, a time analyzer with 3000 channels of one nanosecond width each was built. The measurements exhibit a stability of the order of 3×10^{-4}/°C and the first tests carried out have not allowed any lack in differential or integral linearity to be detected. (auth)

19009 UNIVIBRATOR AS A TIME BASE ELEMENT IN A MEDIUM FAST COINCIDENCE CIRCUIT. Halling, H.; May, F. (Reaktorzentrum, Seibersdorf, Austria). Nucl. Instrum. Methods, 40: 325-9(Mar. 1966).

In a medium-fast coincidence circuit (resolution time variable from 100 ns-11 μs) a univibrator is used as timing element (delay and determination of resolution time). The univibrator is designed to have a constant but adjustable output pulse width. The specifications of the output pulses are given. Theoretical considerations and practical measurements are in good accordance. The univibrator can be used for many applications in nuclear instruments. The described circuits are completely transistorized. (auth)

19010 DEVICE FOR HANDLING OCCASIONAL HIGH-DENSITY INFORMATION IN SCANNED PATTERNS. Seidman, A.; Hutchinson, G. W. (Univ. of Southampton, Eng.). Nucl. Instrum. Methods, 40: 351-2(Mar. 1966).

A description is given of a device that enables any scanning, digitizing and storage system, scanning at a high average rate, to handle occasional or regular increases in information density without loss of data and without reducing the average scanning rate. The device was designed and built for use in conjunction with a television system for digitizing spark chamber tracks, but can also be used in fields such as meteorology, biology, aerial survey, and x-ray analysis where interpretation of patterns by computer may be required. Circuit diagrams are shown. (L.B.S.)

19011 THEORY AND DESIGN OF HIGH INTENSITY U.V. MONOCHROMATORS FOR PHOTOBIOLOGY AND PHOTOCHEMISTRY. Johns, H. E.; Rauth, A. M. (Univ.

of Toronto). Photochem. Photobiol., 4: 673-92 (Sept. 1965).

Recent studies have demonstrated that when thymine and uracil are irradiated with uv light, dimers of these materials are produced. Most such uv radiochemical and radiobiological investigations have been performed using a low pressure mercury lamp which gives most of its energy at 253.7 mμ. However, the reactions involving the production and reversal of thymine and uracil dimers are strongly wavelength dependent so for the investigation of uracil and thymine photochemistry as well as for a variety of other investigations a device which can produce an intense uv beam at a selection of wavelengths is preferred. To achieve this, a monochromator using a large water prism was designed and later altered to take two large blazed gratings placed side by side. The details of construction of this monochromator are described and the pertinent theory is discussed. (TCO)

19012 ELECTRON-EMITTING AND ELECTRON-COLLECTING PROBES AS ION WAVE DETECTORS. Alexeff, I.; Jones, W. D. (Oak Ridge National Lab., Tenn.). Phys. Lett., 20: 269-71 (Feb. 15, 1966). (ORNL-P-1886).

Electron-emitting and electron-collecting probes are experimentally shown to be very sensitive detectors of ion-acoustic waves. Fluctuations in ion density in the sheath surrounding a probe drastically change the rate of electron flow through the sheath. (auth)

19013 MASS ANALYZER AND SIMILAR DEVICES. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-4200. Mar. 5, 1965. Filed July 9, 1962.

In the proposed mass analyzer employing a magnetic field (or similar devices), the resolution in the analysis can be improved considerably by correcting for the curve of ion beams due to the disturbance of the magnetic field. A pair of deflecting electrodes to provide a deflecting electric field are installed between the magnetic field and the ion collector for correcting the curve of an ion beam having the same m/e value due to the non-uniformity of magnetic flux density at the entrance and exit of the ion beam in the magnetic field. (NSA of Japan)

Radiation Detection

Refer also to abstracts 18712, 19310, 19794, 19795, 19813, 19839, 19847, 19851, 20204, 20298, and 20328.

19014 (AD-616703) PPA—A COMPUTER PROGRAM FOR PHOTO-PEAK ANALYSIS. Murphy, Harry M. Jr. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Mar. 1966. 53p. (AFWL-TR-65-111). CFSTI $3.00 cy, $0.50 mn.

PPA (Photo-Peak Analysis) is a simple FORTRAN computer code, that fits photopeaks in pulse-height gamma-ray scintillation spectra, and gives results in terms that are immediately useful to the gamma-ray spectroscopist. PPA fits experimental data with a Gaussian (Normal) distribution function, containing a linear bias term through the use of an iterative, least-squares technique. As many as five photopeaks can be fitted by PPA in any given experimental spectrum with the following results: (1) the exact channel location of the photo-peak; (2) the width of the photo-peak (FWHM); (3) the peak count rate; (4) the integrated photopeak count rate and (5) the integrated photo-peak count rate corrected for radioactive decay to "zero-time." The mathematics involved in the analysis, the input data required, and the results of some experimental measurements, as well as some typical applications of the code are discussed. In addition, a complete FORTRAN listing with flow diagrams is given in an appendix. (auth)

19015 (AD-629511) DESIGN CRITERIA FOR WIDE-RANGE GAMMA RADIACS USING SEMICONDUCTOR DIODE DETECTORS. Wesley, E. J.; Joseph, W. F. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 8, 1966. 39p. (USNRDL-TR-975).

The application of silicon semiconductor detectors to a wide-range, gamma-ray doserate meter using the detectors in a pulse counting mode is discussed. Pertinent circuit and detector characteristics that establish the doserate ranges that can be covered, the energy dependence to be expected from both large lithium-drifted detectors and very small silicon junction diodes, and the stability requirements imposed on the electronics by the pulse mode of operation are reviewed. Methods of tailoring the photon energy response of semiconductor detectors are reviewed. Particular attention is given to the effect on design of amplifier and detector noise and variations in the noise level. One example of a combination of detectors to cover the doserate range from 0.2 mR/h to 2000 R/h is shown. (auth)

19016 (AD-629709) USE OF MOS TRANSISTORS IN SOLID-STATE RADIATION SURVEY METERS. Brayden, Richard; Bowman, Dennis; McSherry, Luke (Army Electronics Command, Fort Monmouth, N. J.). Feb. 1966. 9p. CFSTI $1.00 cy, $0.50 mn.

An all solid-state survey meter using an MOS transistor instead of an electrometer tube was designed and constructed. The survey meter, using one high-megohm resistor, had two scale ranges: 500 mr/hr and 50 mr/hr. Additional scale ranges could be obtained using additional high-megohm resistors. As a result of the work it is apparent that an all solid-state survey meter offers distinct advantages over present-day tube models. Low cost, reliability, and compactness are a few of the major features. In addition, it is seen that it will be possible to integrate the entire circuit on a single chip and encase it in a single header for additional size decrease. (auth)

19017 (AECL-2533) AN AREA GAMMA MONITOR WITH AUTOMATIC RANGE CHANGING. Jones, A. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1965. 14p. Dep. mn. AECL $0.50.

An area gamma monitor is described which is intended for the measurement of exposure rates in the range 0.2 milli-Roentgens/hour to 10 Roentgens/hour. The output is displayed on two quasi-logarithmic ranges and automatic range changing is provided to switch the monitor to the less sensitive scale whenever a selected exposure rate is exceeded. The monitor has a rapid response. The detector unit, containing two Geiger tubes, may be separated from the main unit by at least 300 feet of cable. A detailed circuit description and a setting-up procedure are contained. (auth)

19018 (ANL-7110, pp 231-310) EXPERIMENTAL TECHNIQUES AND FACILITIES. (Argonne National Lab., Ill.).

Counting errors and the dead time of counting systems were studied; and instrumentation was developed for the TREAT sodium loops, along with equipment and techniques for remote encapsulation of pre-irradiated fuel elements for exposure in TREAT. Neutron-detection techniques were studied, and a fast-neutron hodoscope was developed. Methods for measuring capture-to-fission ratios, decay constants, uranium fission rates, and the neutron capture rate of ^{238}U were also studied. A system for the control of a Van de Graaff accelerator by an on-line computer was developed. (D.C.W.)

19019 (CALT-68-27) SUMMARY OF PROCEDURES USED IN CALIBRATING THE PHOTOTUBES FOR THE p anti p EXPERIMENT AT BROOKHAVEN. Internal Report No. 13. Madey, John (California Inst. of Tech., Pasadena. Synchrotron Lab.). Dec. 31, 1964. Contract AT(11-1)-68. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The procedure used to calibrate the 6655A's and the 7046's for the Brookhaven experiment is described in detail. The pertinent electrical and mechanical details of the system used are also given. (M.O.W.)

19020 (CALT-68-30) A LARGE SPARK CHAMBER FIELD-LENS. Internal Report No. 14. Pine, Jerome (California Inst. of Tech., Pasadena. Synchrotron Lab.). Jan. 15, 1965. Contract AT(11-1)-68. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A field lens for viewing a large spark chamber with a 3/8" gap was designed. The lens will be made out of lucite sheet

and mineral oil. The main features and the performance of the first model are discussed. (M.O.W.)

19021 (CALT-68-53) CERENKOV LIGHT ABSORPTION IN SEVERAL SAMPLES OF LUCITE. Internal Report No. 17. Sheng, Ping (California Inst. of Tech., Pasadena. Synchrotron Lab.). Sept. 23, 1965. Contract AT(11-1)-68. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The spectral absorption characteristics were measured for 9 various samples of lucite. Detailed results are presented. (M.O.W.)

19022 (CALT-68-62) A GENERAL RANGE-ENERGY-LIGHT OUTPUT PROGRAM FOR HIGH ENERGY PHYSICS. Groom, Donald E. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Dec. 31, 1965. Contract AT(11-1)-68. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A computer program for calculating a particle's energy loss and light output as it passes through a variety of absorbers and counters is described. (D.C.W.)

19023 (CERN-66-4) THE QUALITY OF THE MEASUREMENTS OF THE FIRST BUBBLE CHAMBER EXPERIMENT PROCESSED WITH THE CERN HPD. Villemoes, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 4, 1966. 57p. Dep. mn.

In connection with the processing of the first bubble chamber experiment using the CERN HPD, a comparison of the results with those obtained from conventional IEP machines is made. The experiment comprises about 21,000 four-prong events produced by the interaction of 5.7 Bev/c antiprotons in the Saclay 81 cm liquid hydrogen bubble chamber, and about 900 of the events were measured on both machines. The comparison is carried out on a track-by-track and an event-by-event basis using the direction angles and curvature for the tracks and the final identification for the events. The part of the comparison sample which is not accepted for physics is also examined for any bias with respect to the accepted part. The comparison shows that the HPD measurements are not inferior to the IEP results, and no bias is detected in the rejected part of the sample. (auth)

19024 (DESY-65/16) ENERGY DEPENDENCE OF SECONDARY EMISSION MONITORS BETWEEN 10 Mev AND 5 Gev. Ladage, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov. 23, 1965. 13p. Dep. mn.

It is shown that the energy dependence of secondary emission monitors built of thin aluminum foils is in agreement with the theoretical treatment of Aggson in the energy range from about 10 Mev to 5 Bev. The secondary emission yield increases logarithmically with energy up to about 1 Bev. Beyond 1 Bev the increase with energy depends on the distance between the foils and, for a foil distance of 1 cm, becomes nearly constant above 2 Bev. For energies beyond 5 Bev (e.g., SLAC), a stable and practically energy independent SEM, built of gold plated aluminum foils with a spacing of 0.5 cm, is recommended. (auth)

19025 (EIR-86) ZERSTOERUNGSFREIE DICKENBESTIMMUNG DUENNER PLANPARALLELER URANOXYDSCHICHTEN. (Nondestructive Thickness Determinations of Thin Parallel-Plane Uranium Oxide Films). Behringer, K.; Lengweiler, K.; Peng, K. (Eidenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan. 1966. 25p. Dep. mn.

The absolute measurement of the thermal neutron flux from reactor beam holes by a parallel plate type fission counter requires the exact knowledge of the thickness respectively the total amount of the uranium coating. Non-destructive thickness determinations on thin uranium-oxide films (0.05-1 mg/cm^2) electro-deposited on aluminum backing were carried out by weighing, x-ray absorption, α-particle counting, and γ spectroscopy. The methods are briefly described. The results obtained by α-particle counting and γ spectroscopy agree well within 5%, while those from the two other methods show deviations up to 20%. (auth)

19026 (INSJ-94) INTENSIFICATION FOR NUCLEAR PLATE. Nagoshi, Chieko; Yamaguchi, Hisashi (Institute for Nuclear Study, Tokyo Univ. (Japan)). Jan. 24, 1966. 20p. Dep. mn.

Methods of particle track intensification in 100 μ plates were tested using chromium, mercury, and silver. The results from these tests are presented. (M.O.W.)

19027 (N-65-16588) SUBNANOSECOND TIME RESOLUTION SINGLE-CHANNEL PULSE-HEIGHT ANALYZER. Fessler, Theodore E.; Roberts, William K. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb. 1965. 12p. (NASA-TN-D-2673). CFSTI $1.00 cy, $0.50 mn.

A fast single-channel pulse-height analyzer that uses a tunnel-diode trigger circuit to generate accurately timed output pulses is described. The analyzer will handle approximately 10^4 random pulses/sec above the lower discriminator level with negligible output pulse loss. (D.C.W.)

19028 (N-65-16844) THE OPTICS OF A COSMIC-RAY DETECTION SYSTEM USING A GAS-FILLED CERENKOV RADIATOR [Thesis]. Snyder, Robert Stuart (North Carolina Univ., Chapel Hill). 1963. Contract NASw-59. 45p. (NASA-CR-51513).

The use of a CO_2-filled Cherenkov detector in a system to determine the charge distribution of the high-energy component of the primary cosmic radiation is studied. The variation of the index of refraction of carbon dioxide with pressure was measured, and this information was used to select the velocity threshold of the particles to be detected. A Cherenkov detector containing carbon dioxide at 30 atm was operated successfully. (STAR)

19029 (N-65-16933) IONIZATION CHAMBER-GEIGER TUBE INSTRUMENT FABRICATION PROGRAM. Final Report. Prince, M. B. (Electro-Optical Systems, Inc., Pasadena, Calif.). Mar. 28, 1964. Contract JPL-950658. 57p. (NASA-CR-60706; EOS-5030-Final). CFSTI $3.00 cy, $0.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Three prototype and three flight ionization chamber-Geiger tube instruments were fabricated; and all units, except the temperature control model, were subjected to vibration and thermal vacuum tests. One prototype was subjected to a more rigorous testing program that included the following: vibration, thermal vacuum, explosive atmosphere, humidity, r-f interference, shock, and static acceleration. The flight instruments will be carried on Mariner C spacecraft, and will detect and measure the omnidirectional flux of corpuscular radiation in interplanetary space and near Mars. The energy detection thresholds are 0.5 Mev for electrons, 10 Mev for protons, and 40 Mev for alpha particles. The instrument assembly consists of ion chamber, Geiger-Mueller tube, and electronics subassemblies. (STAR)

19030 (N-65-17266) AN X-RAY TELESCOPE. Giacconi, R.; Harmon, N. F.; Lacey, R. F.; Szilagyi, Z. (American Science and Engineering, Inc., Cambridge, Mass.). Feb. 1965. Contract NAS5-660. 66p. (NASA-CR-41). CFSTI $3.00 cy, $0.75 mn.

An aplanatic total reflection telescope for use in the soft x-ray region was constructed and tested. The telescope has a collecting area of 2 cm^2, an angular resolution of 1 minute of arc, and a field of view of 40 minutes of arc. The focal length is 64 cm. The grazing angle of incidence on the telescope surface is about 1° for paraxial radiation. This results in an efficiency of reflection of 0.2% in the 8 to 12 Å region and 50% at 44 Å. These characteristics make it particularly suitable for the study of celestial x-ray sources from rocket- and satellite-borne instrumentation. (STAR)

19031 (N-65-19766) BASIC RESEARCH IN SEMICONDUCTOR DETECTOR-DOSIMETER CHARACTERISTICS, AS APPLIED TO THE PROBLEMS OF WHOLE BODY DOSIMETRY. Informal Progress Report. Crawford, George W. (Southern Methodist Univ., Dallas, Tex.). Feb. 1965. 3p. (NASA-CR-57300). CFSTI $1.00 cy, $0.50 mn.

A family of lithium-drifted silicon semiconductor detectors for measuring the stopping power of protons and proton absorption is reported. Stopping power measurements were made for protons of 5 to 187 Mev in metals, plastics, and tissue. A program for calculation of the linear stopping power was completed, tested, and incorporated into a Monte Carlo transport program which permits Coulomb interaction with both orbital electrons and the nuclei. Also, the Monte Carlo program was written to permit calculation of the depth-dose distribution in skin, muscle, and fat. (STAR)

19032 (N-65-23928) PULSE-COUNTING DETECTORS OR LOW-ENERGY PARTICLES AND HIGH-ENERGY PHOTONS. Bi-monthly Report, April 10–June 10, 1964. Russell, J. E. (Avco Corp., Tulsa, Okla.). June 19, 1964. Contract NASw-783. 16p. (NASA-CR-62743; BMR-1). CFSTI $1.00 cy, $0.50 mn.

The extreme u-v source was redesigned to provide a much more intense beam of protons. Also, the electron source and the ion source were made more compatible in regard to control electronics so that one set of electronics for these sources may be rapidly switched from one to the other. Further, two of the multipliers were retested for determination of deterioration due to long exposure to the atmosphere; the initial results were good. An evaluation of several circuit approaches led to the selection of integrated circuit modules for the l-f portion of the circuits. The multiplier amplifier was made more rugged with a frequency response of 60 Mc and a gain of 700; it consumes only 60 mw of power (STAR)

19033 (N-65-26400) STERILIZABLE GEIGER-MUELLER TUBES FOR SPACE APPLICATIONS. Final Report. Weinberg, G. R.; Anton, Nicholas G.; Sturtz, Sidney; Moss, Michael; Youdin, Myron (Eon Corp., Brooklyn, N. Y.). Mar. 22, 1965. Contracts NAS7-100; JPL-CPFF-950681. 145p. (NASA-CR-63394). CFSTI $4.00 cy, $1.00 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Two Geiger-Mueller tubes that can be sterilized using gas and heat are described. The fabrication of the tubes is outlined, and tests of the tubes are summarized. (D.C.W.)

19034 (N-65-27827) MARINER C-64: TRAPPED RADIATION DETECTOR, UNIT 25. Final Engineering Report, May 17, 1963–December 30, 1964. Gabel, R. H.; Skerik, J. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Feb. 19, 1965. Contracts NAS7-100; JPL-950613. 163p. (NASA-CR-63743). CFSTI $5.00 cy, $1.00 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Presented is a technical description of the Mariner C Program, which focuses on the design, fabrication, and testing, of the following models of a trapped radiation experiment: Thermal Control Model, Engineering Prototype/Type Approval, Proof Test Model, First Flight Unit, Second Flight Unit, Flight Spare, and MC-5. The MC-2 experiment was launched aboard the MC-2 spacecraft (Mariner-3) on 5 November, 1964. The mission was unsuccessful although the experiment operated properly. MC-3 was launched aboard the MC-3 spacecraft (Mariner-4) on 28 November, 1964. It has operated properly through 19 February 1965. Included are extensive data on design criteria, bench checkout equipment, and documentation. (STAR)

19035 (NIJS-R-470) A SPECTROMETER FOR 14 Mev NEUTRON CAPTURE SPECTROSCOPY. Cvelbar, F.; Hudoklin, A.; Mihailovic, M. V.; Najzer, M.; Ramsak, V. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). Nov. 1965. 15p. Dep. mn.

A telescopic scintillation pair spectrometer for the measurements of gamma ray spectra from the radiative capture of 14-Mev neutrons is described. The main parts of the spectrometer are: a lead foil as a converter of gamma rays to electron-positron pairs, a 12.5 cm dia × 12.5 cm long plastic scintillator in which the energy of pairs is absorbed, and an arrangement of two thin plastic scintillators. Two thin scintillators together with the appropriate electronics present a coincidence-anticoincidence shield which appreciably reduces the background from charged particles created in the main scintillator or coming into the spectrometer from outside. The meson background in the whole energy range of the spectrometer is reduced to about 0.5 cpm. The energy resolution of the spectrometer is 12.5, 9.5, and 8.0% for gamma rays of 12.1, 16.5, and 20.4 Mev respectively. An average value of the spectrometer efficiency in this energy region is 0.5%. The gamma ray spectrum from the capture of 14 Mev neutrons in ^{56}Fe is shown as an example of the application of the spectrometer. (auth)

19036 (NP-15766) PREOBRAZOVANIE MIKROSEKUNDNYKH INTERVALOV VREMENI V TSIFROVOI KOD. (Conversion of Microsecond Intervals to Digital Code). Report No. 99. Rekhin, E. I.; Lyaporov, V. M.; Pankratov, V. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). [1962]. 20p. Dep. mn.

The small time interval between a starting signal and the moment of counting a particle on a detector can be measured electronically with the use of a delayed starting signal and a converter. Part of the time is measured by means of the delayed starting signal, and the remainder of the time interval is measured with an accuracy determined by the converter. The starting signal starts the generator of timed pulses which go to an address register. A quartz frequency stabilizer is used to obtain a stable channel width. It is desirable to have a fast and slow scheme of time analysis. Detailed electronic circuit diagrams are presented in accomplishing the above objectives. A detailed analysis of various sources of error in measuring short time intervals is presented. The effect of the lack of synchronization in various parts of the converter is discussed. (TTT)

19037 (NYO-3421-6) PHOTOMULTIPLIER INVESTIGATION. Fifth Quarterly Report, November 15, 1965–February 14, 1966. Smith, H. M. Jr. (David Sarnoff Research Center, Princeton, N. J.). Feb. 21, 1966. Contract AT(30-1)-3421. 22p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Two problems often encountered by users of photomultiplier tubes today are those of dark pulses and gain shift with count rate or short term stability. Recent investigations of these problems are presented. Results from the study of afterpulses from single electrons are indicative of a correlation between afterpulses and the larger type B pulses (a correlation which originally seemed not to exist). Since afterpulses from single electrons are larger than single electron pulses, an explanation based on ions feeding back to the cathode requires that each ion generate more than one secondary electron. It was also found that type B pulses are not induced by high single electron count rates in insulatorless tubes where there are no type B pulses to begin with. (auth)

19038 (NYO-10742) INVESTIGATION OF BERYLLIUM WINDOWS FROM CEA BUBBLE CHAMBER. Final Report. Klein, J. L.; Pickett, J. J. (Nuclear Metals, Inc., West Concord, Mass.). Dec. 31, 1965. Contract AT(30-1)-3600. 231p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

A metallurgical investigation of the remains of two Be windows that failed during the accident at the CEA liquid-hydrogen bubble chamber was carried out. Included in the investigation were: a review and evaluation of the design and service conditions for the windows; a review and evaluation of the fabrication and machining procedures used to produce the windows; chemical and spectrographic analysis of the Be remains; detailed visual examination of non-fracture and fracture surfaces of the Be and of the steel cap screws; simulated fracture, impact, and staining tests; identification of the origin of each fragment by machine markings; confirmation of the identities by metallographic examination; reassembly of most of the fragments to the fractured flange sections; x-ray diffraction determination of preferred orientation; radiography; ultrasonic tests; a metallographic study of cleanliness, grain size, and surface damage; density determination; a literature review of the mechanical properties of Be at cryogenic temperatures; tensile tests at 20°C and 20°K; double shear tests at 20°C

and 77°K; bend tests at 20°C; and a detailed stress analysis of the inner window. It is concluded that there is no basis for believing that either window was defective, although failure might not have occurred if the surface damage that unavoidably results from the machining of beryllium had been removed by etching; however, such an etching step was not the responsibility of the vendor, for it was not specified by the buyer. It is also concluded that the inner window failed first and that it failed because the biaxial stresses imposed on it by the structure to which it was mounted and by the liquid hydrogen exceeded the fracture strength of the Be at 27°K; the outer window was fractured by the impact of the shattered inner window and the stream of liquid hydrogen released by the failure of the inner window. Recommendations for prevention of the recurrence of such a failure are presented. (auth)

19039 (RISO-M-233) ON-LINE ANALOGUE COMPUTER FOR ELECTRON SPIN RESONANCE SPECTROMETER. Hoejberg, K. Soee (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Apr. 1965. 15p. Dep. mn.

Analog equipment for double integration of electron spin resonance spectra is described. The given circuit performs computation of correction terms for drift in the input signal from electron spin resonance spectrometer. (auth)

19040 (SGAE-PH-33/1965) EXPERIMENTELLE ERFAHRUNGEN MIT EINEM HALBLEITER-COMPTON-SPEKTROMETER BEI ABBRANDMESSUNGEN AN BRENNSTOFFELEMENTEN. (Experimental Results With a Semiconductor Compton Spectrometer in Consumption Measurements on Fuel Elements). Buba, L.; Hick, H.; Rumpold, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physikinstitut). 1965. 12p.

The experimental results were tested by independent methods such as neutron physical measurements and calculations and by destructive chemical and mass-spectrometric analyses. For an MTR element of the ASTRA reactor, the number of fissions agrees well (4%) within an estimated error of 12%. For a plate divided into 18 sections, from the Brookhaven Graphite Research Reactor, an agreement of 0.5% was obtained for the sum of 10 analyzed fragments. The agreement of the experimental values for the individual sections was, on an average, 6.4%. (tr-auth)

19041 (SLAC-57) 2-METER SPARK CHAMBER MAGNET MODEL FOR THE DETERMINATION OF FIELD DISTRIBUTION IN SPACE. Brechna, H.; Burfine, E.; Mizrahi, R.; Wolff, A. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Jan. 1966. Contract AT(04-3)-515. 72p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A 1/10-scale electromagnetic model of the 2-meter spark chamber magnet to be used at the End Station A area at SLAC was built to determine the axial and radial magnetic field distribution inside and outside the gap. Starting with a symmetric iron core and uniform distribution of ampere-turns on both poles, the model was changed gradually to the form which complies with the present design of the 2-meter spark chamber magnet. Field measurements performed on all models are described. (auth)

19042 (UCRL-14445) A PHOTOTUBE USING A SEMICONDUCTOR DIODE AS THE MULTIPLIER ELEMENT. Kalibjian, Ralph (Lawrence Radiation Lab., Univ. of California, Livermore). Feb. 4, 1966. Contract W-7405-eng-48. 16p. (CONF-660304-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C.

A phototube was developed with a semiconductor diode as the multiplier element. The tube has an electron gain of 1200 at 5 kev and has a linear output current in the 6-amp range with a dynamic range between 10^7 and 10^8. A description is given of the fabrication of the shallow-diffused p-n junction diodes and their use in sealed envelopes with a cesium-antimonide photocathode. Also included is a discussion of the electrostatic lens for focusing the photoelectron beam to the window of the diode, and of the overall operation of the tube. (auth)

19043 (UCRL-16480) A METHOD OF MAKING THIN-WINDOW GERMANIUM DETECTORS. Goulding, Fred S.; Jarrett, Blair V. (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 17, 1966. Contract W-7405-eng-48. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A method is described for producing thin-window lithium-drifted germanium x- or γ-ray detectors. The success of the process is indicated by a high yield of good detectors. Measurements show that the window thickness is in the range of 1 micron or less and x-ray energy resolution figures of 1.4 kev (full width at half minimum) were obtained. Some initial tests using the detectors for long-range proton energy measurements show that the negligible window thicknesses combined with thick depletion layers (easily obtained with germanium) promise to extend the usefulness of semiconductor detectors in particle as well as x-ray experiments. (auth)

19044 (UCRL-16508) THE MULTI-VIEW FOG PROGRAM AND ITS APPLICATION TO QUALITY CONTROL OF FSD DATA. Buckman, Shirley; Franz, Joan; Gotthelfsman, John; Hall, Dennis; Morgan, Vivian; Windorski, Frank (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 29p. (CONF-651044-7). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

Multi-view FOG, an extension of the current 2-view FOG program, will provide a maximum likelihood estimate of the momentum and position vectors of a track near a vertex. It will also provide a reliable discrimination function which will separate good measurements from bad measurements on a statistical basis and will under certain conditions attempt to remove bad points from a track. (M.O.W.)

19045 (UCRL-16509) RESULTS FROM PROTOTYPE DAPR PROGRAMS. Dickens, Charles; Downton, Mary; Pinchak, Joan; White, Howard S. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 29p. (CONF-651044-8). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

Several prototype programs relating to Digital Automatic Pattern Recognition (DAPR) were developed. The results of these prototype programs are presented. (M.O.W.)

19046 (UCRL-16510) THE DAPR PRODUCTION SYSTEM. Hall, Dennis; Pinchak, Joan; White, Howard S. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 1965. Contract W-7405-eng-48. 20p. (CONF-651044-13). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

The ability of the Digital Automatic Pattern Recognition (DAPR) programs to perform the track following operation for bubble chamber data is discussed. The DAPR operations are discussed from the viewpoint of data flow. (M.O.W.)

19047 (UCRL-16595) AN IMPROVED ^{3}He NEUTRON SPECTROMETER [Thesis]. Bair, William Alois (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 21, 1966. Contract W-7405-eng-48. 141p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Preliminary results of a ^{3}He neutron spectrometer being developed at the Lawrence Radiation Laboratory are presented. The spectrometer will be capable of presenting neutron spectra to an upper limit of 14.0 Mev. The spectrometer employs a ^{3}He–Kr gas mixture in a proportional counter, and the reactions ^{3}He(n,p)T and ^{3}He(n,d)D are utilized to obtain the incident neutron energies. Recoils from ^{3}He, Kr, and the stabilizing gas (CO_2) are electronically removed from the spectra by taking advantage of the shorter rise times of the recoil pulses. An analytic analysis of the rise time discrimination pulse rejection, the wall effects, and the spectrometer efficiency is presented. A computer program and an "inversion matrix" are de-

veloped (based on the analytic analysis presented) by means of a "random probability analysis." The "inversion matrix" should permit the correction of a raw neutron spectrum output from a multichannel analyzer to a final neutron spectrum by correcting in a single operation for: (a) rise time discrimination, (b) wall effects, and (c) spectrometer efficiency. Appendices include a table of comparative physical and operational characteristics of all ^{3}He proportional counters and ionization chambers constructed, and reported in the technical literature to date. The complete electronic circuitry necessary to construct the rise time discriminator units, and the computer program "CATMAN" developed for the random probability analysis are also presented as separate appendices. (auth)

19048 AN IMPROVED RADIODENSITOMETER MEASURING ^{14}C ON BIDIMENSIONAL CHROMATOGRAMS. Hammar, Hans; Stroem, Lennart (Univ. of Uppsala). Acta Soc. Med. Upsalien., 70: 107-16(1965).

The optimal characteristics of radiodensitometers for use in evaluation of radioactive chromatograms were considered. Sequential analysis was applied to the recording process of radiochromatograms to distribute available counting time efficiently between background and renal activity. Double sampling is enough to reduce the counting time of an average chromatogram from 25 to 7 hours without increased error and with a small probability to regard areas of weak activity as background. A radiodensitometer with two logic sieving circuits realizing the sampling plan is then described, along with complete circuit diagrams. With the aid of one sieve the time of measuring a chromatogram can be shortened or this gain can be utilized to extend counting of weak spots. With G-M tubes and the geometry described an efficiency of about 7% was obtained and this can be increased substantially by using solid state radiation detectors which also have much lower background rates. With the aid of a second sieve as described, the time of measuring a chromatogram can be reduced by a further 30–50%. This gain can be utilized in counting areas with low activities for a prolonged time and in that way increase the precision by reducing the relative error. It is also pointed out that the statistics presented may be used in other nuclear detection instruments, where a decrease in background counting time becomes a necessity. (TCO)

19049 COMPTON-SCATTERING EXPERIMENT USING LOW-ACTIVITY GAMMA-RAY SOURCES. Chow, R. H.; Herold, J. S. (California State Coll., Long Beach). Amer. J. Phys., 33: 1042-7(Dec. 1965).

An experiment on Compton scattering of gamma rays using low-activity gamma-ray sources usually requires a multichannel pulse-height analyzer if the experiment is to be completed within a reasonable length of time. Herein is described a method not requiring such an analyzer, yet permitting the use of a radioactive source of such low activity as to be available license free. The experiment is within the scope of colleges only modestly equipped. The technique is not restricted to Compton scattering only, but may be used generally for nuclear spectroscopy studies. (auth)

19050 PRECISION HIGH-RESOLUTION MOESSBAUER SPECTROMETER. Nussbaum, Rudi H.; Gerstenfeld, Floyd; Richardson, James K. (Portland State Coll., Oreg.). Amer. J. Phys., 34: 45-52(Jan. 1966).

The design, construction, and performance of a low-cost precision and high-resolution constant-velocity Mössbauer spectrometer, based on a micrometer leadscrew drive, is described. Natural linewidth of 0.19 mm/sec was obtained for the inner two lines of the six-line Fe-hyperfine spectrum. (auth)

19051 DESIGN AND TESTING OF COLLIMATORS FOR EXTERNAL COUNTING OF $^{57}Co\ B_{12}$ IN THE HUMAN LIVER. Moore, B. T.; Hegeman, Jane G. (Veterans Administration Hospital, Albany, N. Y.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 731-6(Mar. 1966).

To control variables encountered during external scintillation counting of the human liver, the design and testing of collimators were investigated. The geometric field of the collimator was analyzed in terms of optics. The isoresponse curve was treated as a near parabola and its approximate volume calculated as a volume of revolution. Count rate obtained during external scintillation counting of organs is shown to be a function of the type of collimator, probe position, probe angle, and bordering and underlying organs. Results showed that in long-term organ-counting studies, data can only be of value when the probe position is geometrically fixed and recorded for subsequent counting. (H.G.D.)

19052 A MULTIPLE-FIELD COLLIMATOR FOR THE MEASUREMENT OF UPTAKE BY THE THYROID. Albarede, P.; Di Paola, R.; Crossard, M. (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 8: 685-95(1965). (In French).

A description is given of an apparatus for complementary pre-collimation that can be fitted on to a collimator for topographical examination. For the functional examinations, various geometries can be obtained with this combined equipment, with the use of several different field sizes and of two measuring distances. The role of the optimal measuring distance is discussed. Performance of the collimator complies with IAEA standards. (auth)

19053 FOUNDATIONS OF CALCULATIONS IN ERROR STATISTICS IN THE MEASUREMENT OF NUCLEAR RADIATION. PART II. Weise, Lothar (Zentralinstitut fuer Reaktorexperimente, Kernforschungsanlage des Landes Nordrhein-Westfalen, Juelich, Ger.). Arch. Tech. Messen, 358: 253-8(Nov. 1965). (In German).

Statistics of systems with variable solution times are considered, particularly for solution times as linear functions of the impulse amplitude and as a function of the arrival time of an impulse. Corrections in solution time for measurement of short-lived isotopes are discussed for counters of the first and second type. Automatic methods for compensation of solution time losses and the capabilities of different counting arrangements for determination of time, particularly for ionization chambers, proportional counters, scintillation counters, multipliers, and Geiger-Mueller counters are outlined; schemes of impulse shapes are illustrated for several of these and for an idealized impulse detector. Capabilities for solution time determination and counting losses in coincidence arrangements and corrections for such determinations are given. Precision of time measurement for nuclear events is discussed. (BBB)

19054 FOUNDATIONS OF CALCULATIONS IN ERROR STATISTICS IN THE MEASUREMENT OF NUCLEAR RADIATION. PART III. Weise, Lothar (Zentralinstitut fuer Reaktorexperimente, Kernforschungsanlage des Landes Nordrhein-Westfalen, Juelich, Ger.). Arch. Tech. Messen, 359: 275-80(Dec. 1965). (In German).

Statistics and its application to scintillation spectrometry is discussed. The mechanism of impulse formation in scintillation counters is reviewed, and the statistical treatment of cascade processes is developed. A formula for scattering of the multiplier anode charge in a scintillator arrangement with monoenergetic nuclear radiation is given. Contributions to total scattering from variation in the number of emitted photons per ionizing particle, the efficiency of photon-photoelectron conversion, inhomogeneity in the crystal and the photocathode and charge on the cathode, intrinsic broadening due to various causes, and variation in multiplier intensification are determined. Statistical deviations caused by the electronics are discussed. The shape of a monochromatic spectral line is determined, and experimental verification of the theory is provided. Energy decay in proportional counters and errors due to the pile-up effect are reviewed. (BBB)

19055 THE RANGE OF RESPONSE OF A CONDUCTION CALORIMETER FOR IONIZING RADIATION FLUXES. Chatelet, Joseph; Moreau, Daniel (CNAM, Paris). Compt. Rend., Ser. B, 262: 99-102(Jan. 10, 1966). (In French).

The apparatus used gives a linear response of better than 1% in the range from 4.3 Mw to 3 w. The calibration line established between 0.5 and 650 Mw by the least squares method permits, by extrapolation, the definition of the correction curve up to 7 w. (tr-auth)

19056 EVALUATION OF GAMMA-RAY PHOTOPEAKS. Mercer, T. T. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Health Phys., 12: 533-9(Apr. 1966).

By converting the normal distribution function into histograms having different ratios of rectangle width to standard deviation, correction factors are obtained that lead to a graphical method of evaluating gamma photopeaks. Examples of the method are given and its limitations are discussed. The method described here provides a simple but accurate technique based on a theoretical analysis of the normal distribution function. (TCO)

19057 CONTINUOUS MONITOR FOR PROMPT DETECTION OF AIRBORNE PLUTONIUM. Alexander, J. M. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Contract AT(07-2)-1. Health Phys., 12: 553-6(Apr. 1966).

A monitor that promply detects low concentrations of airborne alpha contamination was developed at the Savannah River Plant (SRP). Design of the monitor and SRP operating data are presented. (H.G.D.)

19058 PROPORTIONAL DETECTOR PAIR FOR SIMULTANEOUS ALPHA-BETA COUNTING. Wells, I. J. (Phillips Petroleum Co., Idaho Falls, Idaho). Health Phys., 12: 570-1(Apr. 1966).

Design and performance of a unique arrangement of two proportional counters are described. The system permits smears for both alpha and beta activity to be placed in the usual position under the detector, and consists of a beta chamber stacked on top of an alpha detector. (H.G.D.)

19059 METHOD FOR ADDING RANGE AND SAFETY TO G-M SURVEY METERS. Markow, Basil (Army Electronics Command, Fort Monmouth, N. J.). Health Phys., 12: 572(Apr. 1966).

A modification in the usual design of a GM survey meter is described that provides for elimination of swamping characteristics. Experimental measurements show that scale readings, when the meter is in the swamped condition are an exponential function of the dose rate, the reading decreasing exponentially with increasing dose rate. By adding an exponential scale to the usual 20 mR/hr full scale meter, a range of 2 to 10 R/hr may be achieved. (H.G.D.)

19060 MEASUREMENTS OF BUBBLE DENSITY OF HIGH-ENERGY ELECTRON TRACKS IN A BUBBLE CHAMBER. Hofmann, J.; Hugentobler, E. (Univ., Freiburg i.B.). Helv. Phys. Acta, 38: 783-800(1965). (In German).

The bubble-density of electron-tracks in a bubble-chamber filled with Freon was measured. The energy of the electrons varied between 50 and 3700 Mev. The results show a nearly constant value of the bubble-density above an energy of 150 Mev. The comparison between the theory and the experiment shows that the present theory gives no satisfactory explanation of the bubble-density above 150 Mev. (auth)

19061 EXPERIMENTS WITH GERMANIUM γ SPECTROMETERS IN THE CHALK RIVER LABORATORY. Ewan, G. T. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1054-69(July 1965). (In Russian).

The properties of the Li-drifted p-i-n Ge detectors are summarized, including their design and layout, resolution for gamma rays of various energies, efficiency, resolving time, and response to high-energy gammas. The performance of these detectors in recording the gamma decay scheme of ^{134}Cs, in measuring internal conversion coefficients, in determining high-energy levels in deformed even-even nuclei, in measuring the gamma spectrum from the $^{19}F(d,n\gamma)^{20}Ne$ reaction, and in measuring the lifetime of nuclear states by the recoil-nucleus method is described. (M.J.T.)

19062 NEW ASPECTS OF TIME-INTERVAL MEASUREMENTS IN NUCLEAR SPECTROSCOPY. Pisarevskii, A. N.; Efimchik, M. K.; Izokh, V. V.; Chernyavskii, A. F. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1083-8(July 1965). (In Russian).

Three time converters for use in nuclear spectroscopic measurements are described. The gains that can be achieved with regard to size, power consumption, reliability, and resolution by employing tunnel diodes and other semiconductor components in place of vacuum tubes are emphasized. The first instrument is of the Vernier type, employing two tunnel diode oscillators of different frequencies. It produces a sequence of pulses of which the number is proportional to the time between the arrival of successive pulses at two different inputs. The instrument is automatically adjusted 200 times per second by comparison with a 10-Mc crystal-controlled oscillator. It can measure time intervals up to 200 nsec with a resolution of 0.5 nsec. In the second instrument, the pulses from a quartz-crystal-controlled oscillator are gated into a shift register by the arrival of a pulse at one input, and the accumulation of pulses in the register is stopped by the arrival of a pulse at a second input. The arrival of this second pulse also causes the next clock pulse to be gated into one of a number of recording channels selected by the number in the shift register. The channel width of this instrument is 20 nsec. In the third instrument, the time between the arrival of a pulse on either of two input channels and the next following clock pulse is measured by a Vernier circuit, and these times for successive on and off pulses are automatically added and subtracted, respectively, to the number of clock pulses recorded in the interim, thus providing an accurate measurement of the time between the arrivals of the two pulses. With this instrument intervals up to 10 μsec can be measured within an accuracy of 1 nsec. (ATD)

19063 ON THE MAXIMUM RESOLVING POWER OF SEMICONDUCTOR DETECTORS. Alkhazov, G. D.; Vorb'ev, A. A.; Komar, A. P. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1227-32(July 1965). (In Russian).

The ratio of the mean square deviation of the number of electron-hole pairs produced in a semiconductor charged-particle detector to the Fano coefficient is calculated for Si and Ge detectors, using the Fano method and assuming that the ionization process is correctly described by the Shockley model. The error in the calculations is estimated to be 30%. The calculated Fano coefficient for Ge is in agreement with previous experimental values; that for Si is much smaller than experimental values. It is concluded that close to maximum resolution is being achieved with Ge detectors, but that Si detectors can be further improved and are capable of considerably higher resolution than Ge detectors. A temperature dependence of the Fano coefficient is also found. (M.J.T.)

19064 A NEW SUPPLEMENTARY PROGRAM OF AI-100-1 AMPLITUDE ANALYZER. Chursin, G. P.; Shirokii, V. K.; Kanashevich, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1233-5(July 1965). (In Russian).

A supplementary operating program for the AI-100-1 pulse height analyzer, called the time analysis mode, is described. The incoming pulses are accumulated in a register with a dead time of less than 1 μsec for each pulse. After a predetermined counting time, the incoming pulses are blocked for 20 μsec while the register content is routed to the proper channel and the register is cleared to receive the pulses to be stored in the succeeding channel. When all 100 channels are used, their contents are automatically recorded and dumped. Decay curves for activities with half lives from 100 μsec to 1 min can be recorded with good accuracy. Alterations to be made in the AI-100-1 analyzer to realize this operation are described, giving a diagram of a gating circuit to be added to the instrument. (M.J.T.)

19065 DESIGN AND CONSTRUCTION OF AN INEXPENSIVE BETA-GAMMA FLOOR MONITOR. Swanberg,

Stacy C. (Veterans Administration Hospital, Omaha). J. Nucl. Med., 7: 69-71(Jan. 1966).

A beta-gamma floor monitor for controlling inadvertent spread of radioactivity during clinical use of radioisotopes is described. Basically the instrument consists of a plywood box that holds a GM survey meter and serves as support for the one-half inch lead shielding. (H.G.D.)

19066 THE VARIATION OF THE CONVERSION EFFICIENCY OF AN NE 102A PLASTIC SCINTILLATOR WITH X-RAY ENERGY IN THE RANGE 1.8-4.5 kev. Adlam, J. H.; Burcham, J. N. (United Kingdom Atomic Energy Authority, Culham, Eng.). J. Sci. Instrum., 43: 93-6 (Feb. 1966).

The integrated x-ray flux over a certain aperture was measured using a flow proportional counter, and this was compared with the response of a scintillator–photomultiplier combination. The measurements were repeated for several nearly monochromatic x-ray sources. Thus the scintillator–photomultiplier combination was calibrated for several x-ray energies. From this calibration the variation of the scintillator quantum conversion efficiency with x-ray energy was obtained. It was found that the efficiency of the scintillator used (NE 102A) did not vary significantly for x-ray energies from 1.8 to 4.5 kev. (auth)

19067 A TWO-PARAMETER PULSE-HEIGHT ANALYZER. Kahlenbach, M. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 685-97 (Dec. 1965). (In German).

A two-parameter pulse-height analyzer designed in the "Zentralinstitut für Kernforschung" at Rossendorf is described. The analyzer consists of a two-parameter pulse-height converter, a 2048-channel ferrite-core memory, a device for CRT display and a printer. The advantages of the multiparameter measuring method in nuclear physics are described, and possibilities for its application are given. Using block- and pulse-diagrams, the functions of some parts of the analyzer are explained. Moreover, some examples of application are given. (auth)

19068 EIGHT-DECADE RANGE GAMMA MONITOR USING A G-M COUNTER. Weiss, H. (Oesterreichische Hochschule, Vienna). Kerntechnik, 8: 64-7(Feb. 1966). (In German).

The characteristics of an 8-decade range γ monitor are reported. The logarithmic dose output curve was measured. The block diagram and circuitry of the counter are given. (J.S.R.)

19069 THE MEASUREMENT OF THE RANGE-ENERGY RELATION AND STRAGGLING OF α PARTICLES IN AIR USING A SOLID-STATE DETECTOR. Rotondi, E.; Geiger, K. W. (National Research Council, Ottawa, Can.). Nucl. Instrum. Methods, 40: 192-6(Mar. 1966).

The energy loss of α particles was studied with a surface barrier detector making use of its much higher resolution than that of ion chambers used in the older work. The range-energy relation was redetermined with ^{210}Po α particles. The mean range was found to be 3.835 ± 0.010 cm, which is in agreement with previous work. The semiconductor detector made it possible to measure energy straggling over the whole energy range. The range straggling parameter was derived and good agreement was found with the quantum mechanical theory of straggling which takes into account the effect of electron binding. (auth)

19070 EVALUATION OF SEMICONDUCTOR DETECTORS FOR FISSION-FRAGMENT ENERGY MEASUREMENTS. Schmitt, H. W.; Pleasonton, Frances (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 40: 204-8(Mar. 1966). (ORNL-P-1625).

A practical guide for the evaluation of silicon semiconductor detectors for fission fragment energy measurements is given. The evaluation is based on shape parameters associated with the pulse amplitude spectrum for ^{252}Cf spontaneous fission fragments. Reasonable limits for these parameters are suggested and the significance of each is discussed. Measurements of similar parameters for the ^{235}U thermal-neutron fission fragment pulse amplitude spectrum are reported. A method for computer determination of the spectrum parameters is outlined. (auth)

19071 CHARACTERISTICS OF TIME-OF-FLIGHT SPECTROMETER WITH SEMICONDUCTOR TIME-TO-AMPLITUDE CONVERTER. Irigaray, J. L.; Roturier, J.; Petit, G. Y. (Univ. de Bordeaux, Talence, France). Nucl. Instrum. Methods, 40: 221-8(Mar. 1966). (In French)

The improvements that were performed in a fast neutron spectrometer using a time-of-flight method are described. The pulse shape uses avalanche transistors; the time-to-pulse height converter is similar to Grin's circuit. A resolution time (fwhm) of 0.95 ns (for a neutron scintillator 5 cm × 5 cm) was obtained. To find the limit of this resolution time, the time of propagation of light in the scintillator was introduced. This spectrometer was used for measurements of angular distributions in elastic and inelastic scattering of 14 Mev neutrons. It also allowed us to measure the relative light response of our scintillator (polystyrene) for different energies of recoil protons. (auth)

19072 LARGE-VOLUME LITHIUM-DRIFTED GERMANIUM GAMMA-RAY DETECTORS. Fiedler, H. J.; Hughes, L. B.; Kennett, T. J.; Prestwich, W. V.; Wall, B. J. (McMaster Univ., Ontario, Ont.). Nucl. Instrum. Methods, 40: 229-34(Mar. 1966).

A new electroplating method was used for the fabrication of large-volume Ge(Li)-detectors in "wrap-around" configuration. The properties and performance of a 6 cm^3 and a 10 cm^3 detector were investigated. Some applications are described. (auth)

19073 CRYSTAL DENSITY IN SUPERCOOLED RADIATION DETECTOR. Agarwal, V. K.; Gilra, N. K. (Univ. of Roorkee, India). Nucl. Instrum. Methods, 40: 238-40(Mar. 1966).

The density δ, of ice nuclei that should be formed along the path of an ionizing radiation traversing a volume of supercooled water as a result of its homogeneous nucleation was calculated and its dependence on the energy of the radiation and the degree of supercooling is shown. In view of the uncertainty of the value of the ice-water surface free energy, σ, four sets of values were chosen for the purpose of calculation and corresponding four sets of values of δ were obtained. It is shown that the construction of a radiation detector utilizing the principle of homogeneous nucleation in a supercooled liquid when irradiated to high energy particles should be possible. Furthermore it is shown that an experimental determination of δ as a function of temperature will be useful to obtain correct values of σ, at different temperatures. (auth)

19074 A NOTE ON THE RESOLUTION OF TWO-COMPONENT DECAY CURVES: THE INTERCEPT METHOD. Chackett, K. F. (Univ., Birmingham, Eng.). Nucl. Instrum. Methods, 40: 254-6(Mar. 1966).

An alternative method to the well-known "Biller Plot" for the resolution of two-component decay curves is given. The ratio of the two activities can be found graphically and also computed to within any chosen confidence limits. The method was tried out in practice with mixtures of ^{42}K (12.4 h) and ^{43}K (22.0 h) with initial counting rates in excess of 10000 cpm and with mixtures of ^{11}C (20.5 min) and ^{18}F (110 min) with initial counting rates of only about 20 cpm. Results compare well with those obtained using a least-squares program on the CERN IBM-7090 computer. (auth)

19075 PEAK/TOTAL RATIOS FOR NaI(Tl) CRYSTALS. Leutz, H. (Univ., Heidelberg); Schulz, G.; Van Gelderen, L. Nucl. Instrum. Methods, 40: 257-60 (Mar. 1966).

The fraction of γ-quanta totally absorbed in NaI(Tl)-crystals was determined for eight scintillation assemblies having dimensions from 1" dia. × 1" hgt through 8" dia. × 8" hgt. The γ-energies varied from 122 kev to 2.62 Mev and the γ-sources were placed at distances of 10 cm and

50 cm from crystal face. For the crystals up to 5" dia. × 5" hgt collimated γ-beams were also used. The measured ratios are about 10% to 30% lower than the ratios calculated by Miller et al. (auth)

19076 CALCULATED GAMMA-RAY PHOTOFRACTIONS FOR WELL-TYPE SCINTILLATION DETECTORS. Snyder, B. J.; Knoll, G. F. (Univ. of Michigan, Ann Arbor). Nucl. Instrum. Methods, 40: 261-6(Mar. 1966).

Monte Carlo calculations for the photofractions of well-type gamma ray scintillation crystals are described. Leakage of secondary gamma rays, bremsstrahlung and electrons is considered. Calculated photofractions are tabulated for two commonly used well crystals. Comparisons are made between photofractions for NaI, CsI, and CaI_2 scintillation crystals. Absorption and scattering within a homogeneous cylindrical source were considered and results are given for aqueous solutions of monoenergetic sources. (auth)

19077 MEASUREMENTS OF THE FANO FACTOR AND THE ENERGY PER HOLE-ELECTRON PAIR IN GERMANIUM. Antman, S. O. W.; Landis, D. A.; Pehl, R. H. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 40: 272-6(Mar. 1966). (UCRL-16317).

A Fano factor of 0.30 ± 0.03 was measured for germanium with a lithium-drifted semiconductor detector used for measuring gamma-ray energies ranging from 100–2800 kev. A value of 2.98 ± 0.01 ev for the average energy per hole-electron pair at 77°K was measured for gamma-ray peaks in the energy region from 100–1400 kev. (auth)

19078 SILICON SURFACE-BARRIER DETECTORS; FABRICATION, TEST METHODS, PROPERTIES, AND SOME APPLICATIONS. Andersson-Lindstroem, G.; Zausig, B. (I. Institut fuer Experimentalphysik, Hamburg). Nucl. Instrum. Methods, 40: 276-90(Mar. 1966).

Investigations were performed on fabrication methods for silicon surface barrier detectors and their correlated properties. The resulting technique currently applied is presented. The method is based on the use of high resistivity silicon material (10000–30000 Ω·cm). Some special tests and results for several properties are given in detail and examples of applications in nuclear experiments are described. (auth)

19079 FABRICATION METHODS FOR LITHIUM-DRIFTED SURFACE-BARRIER SILICON DETECTORS. Murray, H. M.; Harpster, J. W.; Casper, K. J. (Western Reserve Univ., Cleveland). Nucl. Instrum. Methods, 40: 330-6(Mar. 1966).

Techniques for the fabrication of lithium surface barrier silicon detectors are presented. All important chemical procedures are described in detail. The detectors made by these techniques exhibit resolutions of 15–30 kev on internal conversion electrons when operated at room temperature. (auth)

19080 A COMPARATIVE STUDY OF SEMICONDUCTOR GAMMA SPECTROMETERS FOR SCANNING OF IRRADIATED DRAGON FUEL ELEMENTS. Hick, H. (Reactor Center, Seibersdorf, Austria). Nucl. Instrum. Methods, 40: 337-47(Mar. 1966).

Three types of γ-spectrometers using a Ge-Li-detector (full energy peak spectrometer, anti-Compton spectrometer, Compton-spectrometer) are compared with respect to their usefulness in analysis of complex spectra between 100 kev and 3 Mev. Approximate response functions for various energies are given. (auth)

19081 MODULATION METHODS FOR LOW-LEVEL COUNTING IN THE PRESENCE OF BACKGROUND. Vincent, C. H. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Nucl. Instrum. Methods, 40: 348-50(Mar. 1966).

The modulation method of background suppression described by Bradley and Marks is compared with the orthodox method and a modified method. It is concluded that the Bradley and Marks modulation method using a tuned filter does not give any improvement in the statistical error and in fact causes a slight increase, by a factor of 1.111. (L.B.S.)

19082 ON DEAD-TIME ERRORS BY DIFFERENCE COUNTERS. Lokajicek, M. (Forschungsbetrieb Tesla, Prague). Nucl. Instrum. Methods, 40: 353-4(Mar. 1966). (In German).

A formula was derived for the errors resulting from the dead time of difference counters, for the case where the dead time affects both inputs equally. An expression for the relative errors was derived and the results are presented graphically in dependence on the count rate and dead time. It is shown that in the case where both pulses are affected equally, the relative error is much smaller than the doubled value for the case where both arrivals are not affected by the individual difference counters. (L.B.S.)

19083 A PRINCIPLE OF GAIN STABILIZATION OF SCINTILLATION COUNTERS. Tamm, U. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods, 40: 355-6(Mar. 1966). (In German).

A stabilization circuit was developed, which regulates the instabilities occurring in scintillation counters. The circuit has a control factor that is largely dependent on the position of the operating point on the characteristic curve of the control elements. It can be used for cases in which an impressed line is present in the spectrum, which serves as a reference line for the stability. The stabilization principle is discussed, and a block diagram of the control circuit and the circuit diagram of the control-potential generator are shown. (L.B.S.)

19084 SOME CONTRIBUTIONS OF EXTERNAL COUNTING TECHNIQUES TO STUDIES OF THE METABOLISM OF RADIONUCLIDES USED IN TUMOUR THERAPY AND DIAGNOSIS. Trott, N. G.; Cottrall, M. F. (Royal Cancer Hospital, London. Royal Marsden Hospital, London). Nucl.-Med., Suppl. 3, 249-61(1965).

Descriptions are given of several types of external counting systems, used in measurements of the retention and redistribution of radioactive materials in patients, following the administration of both tracer and therapeutic quantities. A single plastic scintillation detector mounted 1.7 m above the patient's bed is proving convenient for measurements of the retention of ^{131}I following the administration of activities of 100 to 200 mC in treatment for thyroid carcinoma. For measurements over a wide range of activities down to levels of about 0.1 μC γ-emitting nuclide, a low background multicrystal γ spectrometer was developed. Several illustrations are given of applications of the system. (TCO)

19085 QUANTITATIVE ANALYSIS OF DATA FROM SCINTILLATION CAMERAS. Myers, M. J.; Kenny, P. J.; Laughlin, J. S. (Sloan-Kettering Inst. for Cancer Research, New York). Nucleonics, 24: 58-61(Feb. 1966).

A quantitative method is described for analyzing data from a commercial model of a scintillation camera. This method permits the determination of the intrinsic and over-resolutions as well as the range of energies over which the instrument can be used in nuclear medicine. The analysis of the positioning signals, the resolution, and the experimental method are described. Quantitative results are also presented. (J.F.P.)

19086 HO WU LI T'AN TS'E CH'I CHI CH'I YING YUNG. (Nuclear Physics Detection Instruments and Their Application). Peking, K'o Hsueh Ch'u Pan She, 1964. 575p.

19087 HIGH-RESOLUTION PHOTON SPECTROMETRY WITH LITHIUM-DRIFTED GERMANIUM DETECTORS. Bilger, H. R.; Sherman, I. S. (Argonne National Lab., Ill.). Phys. Lett., 20: 513-16(Mar. 15, 1966).

Line-widths of 850 ev (f.w.h.m.) were obtained for γ rays below 100 kev with new field-effect transistors in the preamplifier used with germanium detectors. The "doublet" of ^{133}Ba (cascade γ rays from ^{133}Cs) at 80 kev, which consists of two lines 1.5 kev apart, was partially resolved. (auth)

19088 DEAD TIME AND RECOVERY TIME OF G-M COUNTERS AS A FUNCTION OF COUNTER VOLTAGE. Lindeman, H.; Mornel, E. (Israel Inst. of Tech., Haifa). Physica, 31: 1756-60(Dec. 1965).

With the use of scaling factor statistics described earlier, the dependence of the dead time t_d and the recovery time t_r of a G-M counter on the operating counter voltage V_0 were investigated. The results were compared with the formulas for t_d and t_r obtained from Stever's theory of the discharge mechanism of the counter. It was found that the measurements of t_r are in rather good agreement with Stever's theory, but those of t_d are definitely not. In conclusion, it is pointed out that it would be interesting to take up again the problem of the discharge mechanism in order to clear up the existing inconsistencies regarding the dead time. (auth)

19089 AN IMAGE TUBE SCINTILLATION CAMERA FOR USE WITH RADIOACTIVE ISOTOPES EMITTING LOW-ENERGY PHOTONS. Ter-Pogossian, Michel M. (Washington Univ., St. Louis); Niklas, Wilfrid F.; Ball, Jack; Eichling, John O. Radiology, 86: 463-9(Mar. 1966).

A scintillation camera composed of a two-stage image converter tube coupled to a closed-circuit Orthicon television chain is described. The scintillation camera is useful for the visualization of organs and structures containing radioactive substances emitting low-energy x- or γ-ray photons. It is capable of providing images of organs containing approximately half a microcurie per gram of radioactive substance in a period of a few seconds. The resolution of the described camera is limited for practical purposes only by the design of the collimator and by the statistics of the photons impinging upon the screen. (TCO)

19090 THE SCINTILLATION COUNTER PLATEAU FOR GAMMA DETECTION. Haasbroek, F. J. (Fruit and Food Tech. Research Inst., Stellenbosch, S. Africa). S. Afr. J. Agr. Sci., 8: 785-96(1965).

The use of two well-type NaI(Tl)-crystal scintillation counters under differential and plateau conditions was investigated. While the former method required complicated and highly stabilized instruments, excellent plateaus varying from 150 to 200 v, and with slopes of 1.5%/100 v to 2.6%/100 v were obtained, even when a crystal with low resolution and fairly simple instruments were used. It was also established that measurements under the scintillation counter plateau included more than 98% of the γ interactions in the crystals, that no interference is caused by photomultiplier noise pulses and after-pulsing, and that long-term stability is obtained. The scintillation counter has now been in use for several years under plateau conditions and its long-term stability is excellent, as revealed by frequent measurements with a uranium standard. The equipment described is therefore ideally suited for long-term experiments and especially for accurate half life determinations. This method has been used successfully in the assay of mixtures of ^{32}P and ^{65}Zn and in plant studies using ^{65}Zn. It was also confirmed that counting rates exceeding 10^6 cpm could be recorded accurately which exceeds all normal requirements. (BBB)

19091 CONTROL MEASUREMENTS OF ACTIVITY IN NUCLEAR MEDICINE. Jirounek, P.; Boucek, J. (Karolvy Univ., Prague). Sb. Lek., 67: 41-4(Feb. 1965). (In Czech).

Methods and instruments used in the laboratory for measurement of radioisotopes are described. For higher activities rate meters are used, but for assay of low activities an ionization chamber is used. A diagram of the construction of the ionization chamber is presented. Measurements of dose rates are plotted against source intensity at various source-measurement distances for ^{131}I, ^{132}I, ^{198}Au, and ^{75}Se. The methods of measurement described briefly have been found to be adequate in regard to accuracy and to range of source intensity measured insofar as they are applicable to clinical application and use of radioisotopes at medical centers. (BBB)

19092 SCINTILLATION COUNTER FOR MEASURING THERMAL NEUTRONS IN A SOIL-WATER SYSTEM. Perrier, Eugene R.; Stockinger, Karl R.; Swain, Robert V. (Dept. of Agriculture, Brawley, Calif.). Soil Sci., 101: 125-9(Feb. 1966).

A thermal neutron probe using a scintillation crystal as a detector was developed. This probe has a greater sensitivity and higher count rate than the standard BF_3 probe. The higher count rate permits the use of a rate meter that reduces counting times to 2 to 10 seconds for a 1% standard error. The location of soil-water interfaces is easily determined because of the source-detector geometry of the probe. (auth)

Radiation Effects

19093 (AD-629948) RADIATION EFFECTS ON (MONOLITHIC) MICROELECTRONIC CIRCUITS. Quarterly Report No. 2, August 1, 1965-October 31, 1965. Perkins, C. W.; Marshall, R. W.; Mitchell, E. P.; Liebschutz, A. M. (Hughes Aircraft Co., Fullerton, Calif.). Mar. 1966. Contract DA 28-043 AMC-01313(E). 33p. (FR-65-10-252; ECOM-01313-2).

The mechanism and extent of transient and permanent effects of high intensity nuclear radiation on semiconductor integrated microelectronic circuits were investigated. Minor changes made during this quarter in the planned instrumentation and experimental procedures are reported. The linac tests for the circuit evaluation of transient effects were performed. Preliminary pulsed reactor tests were performed on a single circuit for the permanent damage portion of the circuit evaluation. Results from these tests are presented. (M.O.W.)

19094 (INR-657/II/PL) THE USE OF OPTICAL METHODS IN STUDIES OF RADIATION DAMAGE IN LOW-TEMPERATURE ELECTRON-IRRADIATED GERMANIUM. Piekoszewski, J.; Baruch, P. (Institute of Nuclear Research, Warsaw (Poland)). Oct. 1965. 18p. Dep.

Preliminary experiments of 1.7 Mev electron irradiation of n-type germanium samples at 15°K were carried out. The irradiation was performed both in darkness and with an infrared illumination of the samples. In both cases the changes of resistivity and the absorption spectrum in the range of 2.5 - 15 μ was measured. The results seem to show the dependence of the efficiency of defects creation on the electron occupation of defects. (auth)

19095 (N-65-16347) LOW-ENERGY PROTON DAMAGE EFFECTS IN SILICON AND GALLIUM ARSENIDE SOLAR CELLS. Brown, D. M. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1965]. 20p. (NASA-TM-X-54990). CFSTI $1.00 cy, $0.50 mn.

Silicon n-p cells of various base resistivities and gallium arsenide p-n solar cells were irradiated with nominally 0.6, 1.8 and 4.7 Mev protons. In the first experiment silicon n-p cells of various base resistivities and gallium arsenide cells were irradiated with 4.7 Mev protons, measuring I_{sc} and V open as functions of flux. In the second experiment, the same types of cells were irradiated with 0.6 Mev protons, with I-V curves and spectral responses being measured. In the third experiment, a similar set of cells were irradiated with 1.8 Mev protons, with I-V curve and spectral response being measured. (auth)

19096 (N-65-17884) RADIATION-RESISTANT ELECTRONICS. Final Progress Report, January 1-September 30, 1963. Clute, C. H.; Morris, H.; Meyer, O. L.; Scales III, J. L. (Harry Diamond Labs., Washington, D. C.). [1963]. Contract NASw-251. 52p. (NASA-CR-60938; HDL-PR-64-1). CFSTI $3.00 cy, $0.50 mn.

Although experiments were performed with aluminum-aluminum oxide-aluminum sandwiches, the emphasis of the experiments was changed to gold-silicon monoxide-gold structures since these are amenable to interferometric measurement of the insulator layer. Early experiments with the latter system produced many short circuits. Underlaying the gold electrode with oxidized bismuth, producing a feather edge on this electrode, and annealing the composite structure prior to a carefully controlled silicon monoxide deposition dramatically reduced the incidence of

short circuits. It is now possible to produce these sandwiches with only 75 Å of silicon monoxide between the gold layers without short circuits. A large number of thin-film diodes were made and their electrical behavior was examined. Work was continued on the preparation of thin-film, aluminum–cadmium sulfide–gold diodes for possible collector structures. When these were subjected to an appropriate heat treatment, they developed pronounced rectifying characteristics, thereby reinforcing the idea that a successful thin-film collector could be made in this manner. (STAR)

19097 (N–65–17886) RADIATION-RESISTANT DEVICE PHENOMENA. Follmer, William C.; Berman, Arnold (Philco Corp., Blue Bell, Pa. Applied Research Lab.). Dec. 1964. Contract NASw-997. 72p. (NASA-CR-60944). CFSTI $3.00 cy, $0.75 mn.

The equipment that is required to perform fundamental measurements on electron transport through thin metal films and the development of reactively evaporated aluminum oxide films for use in thin-film devices are described. A majority of the facilities required for the controlled production of reactively evaporated aluminum oxide films were designed and constructed. These facilities include a high-vacuum system and drybox assembly to prevent film contamination, a resonant quartz microscale deposition rate monitor and controller, and an oxygen-pressure servocontrol system. (STAR)

19098 (N–65–17953) A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT. Quarterly Report No. 5, January 1–March 31, 1964. Hanks, C. L.; Hamman, D. J.; Wyler, E. N. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1964. Contracts NAS7-100; JPL-950458. 20p. (NASA-CR-60984). CFSTI $1.00 cy, $0.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

The results of a preliminary analysis of the data obtained from the irradiation of electronic components in a high-flux capsule are presented. Exposure to a combined environment of elevated temperature (100°C), vacuum (10^{-5} torr or less), and nuclear radiation (3×10^7 n cm^2 sec^{-1} and 1×10^7 ergs g^{-1} hr^{-1}) for 100 hours had little or no effect on the component parts other than the semiconductor devices. Insulation resistance measurements actually showed improvement, which may be attributed to the removal or reduction of surface leakage possibly due to the combined effects of vacuum and elevated temperature. Radiation exposure had a pronounced effect on all of the semiconductors. Twenty cadmium sulfide cells were irradiated with a ^{60}Co gamma source. The exposure was 1.04×10^6 ergs g^{-1} hr^{-1}. The cells were still sensitive to light but showed a degradation in cell resistance under dim illumination. (STAR)

19099 (N–65–17954) A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT. Quarterly Report No. 7, July 1–September 30, 1964. Hanks, Carl L.; Hamman, Donald J. (Battelle Memorial Inst., Columbus, Ohio). Oct. 13, 1964. Contracts NAS7-100; JPL-950458. 10p. (NASA-CR-60983). CFSTI $1.00 cy, $0.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Twenty-two of 28 irradiated transistors tested were beyond the control limits of the loading circuits. These 22 transistors shorted within 24 hr after the test was started. Two other transistors, which shorted within 48 hr, were beyond the control limits of their loading circuits. One additional failure was a capacitor operating in the 10,000-hr, low-flux, 50°C radiation capsule, which was shorted after 144 hr of exposure to test conditions. (STAR)

19100 (N–65–18004) NEUTRON RADIATION EFFECTS ON MICRO CIRCUIT DIGITAL GATES. Gaines, Bernard (Arma Div., American Bosch Arma Corp., Garden City, N. Y.). June 1964. 8p. (DS–64–R371–44).

A monolithic integrated circuit made up of a multiple emitter input transistor, a 1600-ohm resistor, and an inverter diffused into a Si substrate was irradiated by neutrons up to 3×10^{14} n/cm^2 to determine the effect of neutron damage in microcircuits. The current at the transistor remained constant through the neutron irradiation at 2 mamp. The input leakage current was lower than its original value, and this decrease in back leakage was observed on other devices tested. The voltage remained constant at approximately 0.28 v for the 12-mamp collector current up to about 3×10^{13} n/cm^2 and then rose to a value of about 0.35 v at 3×10^{14} neutrons/cm^2. No changes were observed 30 minutes after irradiation at 3×10^{14} neutrons/cm^2. (STAR)

19101 (N–65–19687) DEVELOPMENT OF AN IMPROVED RADIATION-RESISTANT SOLAR CELL. Final Report, September 27, 1963–December 27, 1964. Rolik, G. P. (Electro-Optical Systems, Inc., Pasadena, Calif.). Contract NAS5-3560. 81p. (NASA-CR-57287; EOS-4370-Final). CFSTI $3.00 cy, $0.75 mn.

The results of a program to develop an improved radiation-resistant solar cell by the incorporation of an electric field are described. Included are the results of a theoretical computer evaluation, drift field fabrication experiments, and radiation damage data. A significant correlation was observed between the theoretical considerations and experimental results, which showed that the optimum drift field thickness lies between 50 and 100 microns. (auth)

19102 (N–65–19693) RADIATION DAMAGE IN SILICON. Final Report, October 15, 1963–October 15, 1964. Almeleh, N.; Goldstein, B.; Wysocki, J. J. (RCA Labs., Radio Corp. of America, Princeton, N. J.). Contract NAS5-3788. 50p. (NASA-CR-57297). CFSTI $2.00 cy, $0.50 mn.

Electron paramagnetic resonance studies were made of the dominant paramagnetic defect produced in a p-type silicon when bombarded by electrons at energies from 1 to 6.6 Mev. Diffusion length measurements were used to study the effects of impurities on radiation damage in silicon produced by electron bombardment. The diffusion of lithium throughout n-type silicon reduces its resistivity, yet the radiation damage resistance of surface barrier cells made from this material is typical of the prediffused material. Of all the impurities studied to date, only lithium has been found to give new and promising results. The interaction between lithium and radiation-induced defects in silicon was measured by electron paramagnetic resonance. Simultaneous measurements of both the lithium resonance and the damage resonance were made as functions of the lithium content and the bombarding electron flux at 6 Mev; an increase in one invariably produces a concomitant decrease in the other. Whether this involves the complexing of lithium with a damage center or merely the supplying of a donor electron from lithium to the damage center is not clear. For a clarification of this point, electron bombardments at much lower energies, about 1 Mev, are required. (auth)

19103 (N–65–19758) COMPONENTS IRRADIATION TEST NO. 8: 2N918 TRANSISTORS; IN250 DIODES; TANTALUM CAPACITORS. (Lockheed-Georgia Co., Marietta). Oct. 30, 1964. Contract NAS8-5332. 69p. (NASA-CR-57352; ER-7686). CFSTI $3.00 cy, $0.75 mn.

Transistors and diodes were subjected to nuclear radiation at a controlled temperature of 46°C. Capacitors were irradiated in a vacuum environment at ambient temperature. Both capacitance and leakage of the capacitors were increased by irradiation. However, both increases appeared to be primarily radiation rate phenomena with no significant permanent change from pretest values. (auth)

19104 (N–65–19867) AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS. Semiannual Status Report, July 1–December 31, 1964. Compton, W. Dale (Illinois Univ., Urbana. Dept. of Physics). 13p. (NASA-CR-57471). CFSTI $1.00 cy, $0.50 mn.

The Si–A, Si–E, and Si–J centers of previously established silicon defects were studied. The silicon-A center consists of a substitutional oxygen atom, and the Si–E center consists of a silicon vacancy trapped next to a substitutional phosphorous impurity. The Si–J center describes the prominent defect in p-type silicon, a divacancy

found in two states dependent on the proximity of the Fermi level to the valence or to the conduction band. Each of these defects can act as recombination centers, and thereby influence the lifetime of minority carriers that are released in the crystal by a short pulse of light. After solving the problem of necessary surface treatment of the samples, the recombination luminescence of a sample of one ohm-cm p-type silicon was determined. Information on the radiation-induced changes in conduction near the liquid helium band and its application to the proposed models of impurity conduction is discussed. (STAR)

19105 (N-65-19870) CHARGED PARTICLE RADIATION DAMAGE IN SEMICONDUCTORS. X. THE ENERGY DEPENDENCE OF ELECTRON DAMAGE IN SILICON. (Space Technology Labs., Inc., Redondo Beach, Calif.). Sept. 3, 1964. Contract NAS5-3805. 43p. (NASA-CR-57478; STL-4161-6004-KU-000). CFSTI $2.00 cy, $0.50 mn.

Test specimens of both p-on-n, and n-on-p silicon solar cells, and bulk n-type and p-type silicon materials were investigated for their use in satellite solar cell power supply systems. Experiments were performed to obtain statistically significant and accurate data on the energy dependence of electron radiation damage, determine the effect of resistivity on the damage rate and energy dependence, and to obtain added specimens and information for further analysis of the energy levels and defect mechanisms responsible for electron damage in silicon. An accurate energy dependence function over the range from 0.4 to 40.0 Mev was established. Extrapolation of the damage rate vs energy characteristics indicates the superior radiation resistance of the n-on-p cell to the p-on-n cell to electron energies beyond 1 Bev. Theoretical analysis of the electron degraded n-on-p solar cells indicates that an energy level 0.17 ev below the conduction band controls the recombination. The Hall coefficient data for the energy dependence of the defect introduction rate were found roughly similar to the energy dependence of solar cell degradation. (STAR)

19106 (N-65-19886) RADIATION DAMAGE IN SILICON. Semiannual Report No. 1, October 15, 1963–April 15, 1964. Almeleh, N.; Goldstein, B.; Shaham, Y.; Wysocki, J. J. (RCA Labs., Radio Corp. of America, Princeton, N. J.). May 1964. Contract NAS5-3788. 34p. (NASA-CR-57505). CFSTI $2.00 cy, $0.50 mn.

Electron paramagnetic resonance studies at 27°K of a newly observed center in electron-irradiated p-type silicon yielded the following information. The principal axes are ⟨221⟩, ⟨1$\bar{1}$0⟩, and ⟨11$\bar{4}$⟩ with respective g-values of 2.0000, 2.0066, and 2.0056. Preliminary measurements of introduction rates at various bombardment energies are 0.25 cm^{-1} at 6.6 Mev, 0.22 cm^{-1} at 5.5 Mev, and 0.15 cm^{-1} at 3.0 Mev. Studies of the effects of impurities on radiation characteristics in silicon include diffusion length measurements using surface-barrier diodes and EPR measurements of lithium-doped silicon. Techniques were successfully applied to the fabrication of the diodes and to lithium doping of the silicon. The paramagnetic resonance due to lithium was observed at 27°K. It consists of one narrow line with a g-value of 1.9997. Bombardment-induced changes in the photovoltaic parameters of Si p/n, Si n/p, and GaAs p/n solar cells were measured for protons with energies in the range 185 to 545 kev. In the GaAs cell, the short-circuit current changed most during irradiation, while in both types of Si cells the shape of the I-V characteristic and the open-circuit voltage were more sensitive to radiation than the short-circuit current. The rate of change of these parameters per incident particle increases with proton energy. (auth)

19107 (N-65-21263) RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS. Tenth Monthly Progress Letter, July 1964. (Bendix Systems Div., Bendix Corp., Ann Arbor, Mich.). Aug. 17, 1964. Contract AF29(601)-5911. 6p. (BSR-1008).

The program progress schedule, accomplishment of major portions of the program, total program expenditures and budget, and program personnel loading charts are presented. The initial analysis, including collection of data, radiation effects analysis, and design of experiments, is included. Preparation of test instrumentation, gamma tests, and reactor tests are considered. Radiation effects are contained in the final analysis. (STAR)

19108 (N-65-21459) RADIATION EFFECTS ON SILICON. Quarterly Progress Report No. 2, September 1–November 30, 1964. Lintz, H. K.; Snowden, D. P.; van Lint, V. A. J. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Dec. 14, 1964. Contract NAS7-289. 19p. (NASA-CR-62191; GACD-5974). CFSTI $1.00 cy, $0.50 mn.

The primary data from electron spin resonance measurements on P-doped n-type floating-zone silicon are values of the introduction rate of the vacancy-phosphorus defect produced by room-temperature irradiation at 8, 15, and 30 Mev. In addition one, and possibly two, previously unreported centers were observed in 0.1 ohm-cm P-doped silicon irradiated at 300°K with 30 Mev electrons with fluxes between 3.7×10^{16} and 9.2×10^{16} cm^{-2}. The Fermi level in these samples is above that value for which the vacancy-phosphorus resonance is seen. Carrier lifetime measurements were made on n- and p-type silicon by the pulsed d-c conductivity method. The microwave method was used to check the pulsed d-c measurements for possible errors introduced by the contacts. The data-reduction computer program was modified to eliminate extensive manual plotting and fitting of decay curves. Measurements were taken rapidly at a large number of temperatures to form a continuous curve of $\tau(T)$. Measuring circuit improvements decreased the rf noise interference, allowing more accurate measurements of short decay times. (STAR)

19109 (N-65-21743) ENVIRONMENTAL EMP SIMULATOR: PORTABLE AND FIXED INSTALLATIONS. (MHD Research, Inc., Newport Beach, Calif.). Mar. 12, 1964. 7p.

A simulator that was developed to study the effects on military electronic and electrical systems of the high-intensity electromagnetic fields in the vicinity of a nuclear explosion is described. The simulator will produce damped 1-f sinusoidal electric and magnetic fields over a volume of several cubic meters. (D.C.W.)

19110 (N-65-21762) RADIATION EFFECTS ON SILICON. Quarterly Progress Report No. 3, December 1, 1964–February 28, 1965. Nichols, D. K.; Snowden, D. P.; van Lint, V. A. J. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Mar. 15, 1965. Contract NAS7-289. 17p. (NASA-CR-62241; GACD-6249). CFSTI $1.00 cy, $0.50 mn.

Measurements of the introduction rate of the silicon G-8 center, the vacancy-phosphor defect, were completed, and their energy dependence was plotted. The relative accuracy of the results is estimated to be ±15%. The divacancy in floating-zone p-type silicon, irradiated at 300°K and doped with 1.2×10^{17} cm^{-3} boron, showed large and easily measured resonance signals. The introduction rates for those divacancies formed directly by the incident electrons, and those subsequently formed by the combination of single vacancies are presented in combined form. Lifetime measurements on n- and p-type silicon were performed by the d-c conductivity and the microwave conductivity techniques, and an analysis was performed on some p-type d-c experiments. The results of 10 ohm-cm p-type silicon irradiated with 30-Mev electrons show that the high-injection level lifetimes are independent of temperature, but that a strong temperature dependence is observed in low-injection lifetimes. From experimental data and theoretical calculations it was concluded that the recombination center in p-type irradiated silicons is a net donor which lies below the center of the gap and has an activation energy of ~0.35 ev. (STAR)

19111 (NP-15910) RESULTS OF EXPOSURE OF A THRESHOLD DETECTOR CIRCUIT TO A FLASH X-RAY ENVIRONMENT. Schaffer, A. M.; Hamman, D. J. (Battelle Memorial Inst., Columbus, Ohio). Nov. 15, 1965. 12p.

The results of a study of pulsed bremsstrahlung irradiation of a Bendix trigger circuit are summarized. The purpose of the experiment was to confirm a PREDICT computer analysis of the circuit, which indicated that it would trigger with a 20-ns radiation pulse at a threshold exposure rate between 1 and 2×10^8 roentgens/second. In addition, photocurrent waveshapes for the transistors were determined. (M.O.W.)

19112 RADIATION-INDUCED CONDUCTIVITY AND THE STEM EFFECT. Beentjes, L. R.; Garrett, F. A. (Univ. of Texas, Galveston). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 791-3(Mar. 1966).

Measurements were made on ionization chambers of the relative sensitivity of the stem as dependent upon applied voltage. It is shown that the stem effect is not a constant fraction but a variable, changing with the voltage between the electrodes. The linearity of the stem effect was checked also as a function of exposed stem length by measuring the contributions of parts of the pure stem. (H.G.D.)

19113 EFFECTS OF X-RAY IRRADIATION ON THE CHARACTERISTICS OF METAL OXIDE–SILICON STRUCTURES. Collins, D. R.; Sah, C. T. (Univ. of Illinois, Urbana). Appl. Phys. Lett., 8: 124-6(Mar. 1, 966).

Evidence is presented which shows that x rays generated by 10-kev electrons from an electron gun can cause reversible damage both near the oxide-silicon interface and in the bulk silicon of MOS structures. The capacitance-voltage curves for irradiated and nonirradiated samples before and after heating have the same general shape and are only displaced along the voltage axis. This indicates that the x-ray damage is near the SiO_2-Si interface. The effects of x rays produced by a commercial x-ray tube using the MOS structure are also shown. (J.F.P.)

19114 ANNEALING OF RADIATION-INDUCED DEFECTS IN SILICON. Fang, P. H. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Lett., 20: 343-4(Mar. 1, 1966).

In a systematic study of the thermal annealing of silicon solar cells damaged by electron radiation, it was observed that a complete recovery can be achieved when the electron flux is below a threshold value. The evidence of this threshold phenomenon and possible physical interpretations are reported. (auth)

19115 TEMPERATURE DEPENDENCE OF RADIATION DAMAGE IN SILICON. Fang, P. H. (Goddard Space Flight Center, Greenbelt, Md.); Liu, Y. M. Phys. Lett., 20: 344-6(Mar. 1, 1966).

A reverse annealing observed in the thermal annealing of silicon damaged by electron radiation is reported. The occurrence of this reverse annealing depends on the temperature of the specimen during the irradiation, and also on the history of annealing. (auth)

ISOTOPE TECHNOLOGY

General

19116 (ORNL-IIC-6) LIST OF AEC RADIOISOTOPE CUSTOMERS WITH SUMMARY OF RADIOISOTOPE SHIPMENTS, FY 1965. Baker, P. S. (comp.) (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 75p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Alphabetical lists are given for: customers, with contacts and isotopes purchased; isotopes, cross-referenced to customer numbers; and states and countries, cross-referenced to customer numbers. A comprehensive table that includes an alphabetical listing of the isotopes and a breakdown into shipments, quantities, and dollars for each isotope under the domestic, foreign, and project (AEC facilities) categories is also given. (P.C.H.)

19117 (ORNL-TM-1356(Suppl.1)) SELECTED ABSTRACTS OF NON-U. S. LITERATURE ON PRODUCTION AND INDUSTRIAL USES OF RADIOISOTOPES. Gerrard, Martha; Baker, P. S.; Lafferty, Robert H. Jr. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

More than 200 abstracts of non-U. S. publications on production and use of radioisotopes and radiation, selected from the October–December 1965 issues of Nuclear Science Abstracts, are presented. (auth)

19118 EFFECT OF IRON ON THE DETERMINATION OF MOISTURE CONTENT BY THE NEUTRON METHOD. Burn, K. N. (National Research Council of Canada, Ottawa). Can. J. Earth Sci., 3: 129-32(Feb. 1966). (NRC-8770).

The method depends on the measurement of loss of kinetic energy by a stream of high-energy neutrons when they strike hydrogen atoms. Thus, the loss is proportional to the number of hydrogen atoms (in water) present and the moisture content may be estimated quickly. Experiments showed that the calibration curve for the instrument must be adjusted for various soil types depending on the natural iron content and, to a lesser extent, that of chlorine and potassium. (F.S.A.)

19119 BETA ATTENUATION—A TECHNIQUE FOR ESTIMATING FORAGE YIELD IN SITU. Teare, I. D.; Mott, G. O.; Eaton, J. R. (Purdue Univ., West Lafayette, Ind.). Radiat. Bot., 6: 7-11(Feb. 1966).

A new, rapid method of estimating forage yield is proposed using the thickness gauging principle, where beta particle attenuation by plant material is considered a direct measure of the density (D) of the plant material. When these measurements are summed over height (H), a term representing $D \times H$ is obtained that has been shown to predict green matter yield very accurately. Simple regression analysis shows that the variable obtained by the Beta-foliageometer accounted for approximately 98 per cent of the variation in green matter yield. The advantage of the proposed Beta-foliageometer is that the method is rapid and gives accurate determinations of forage yield in situ. (auth)

19120 THIRD WORK SESSION ON STABLE ISOTOPES FROM OCTOBER 28 TO NOVEMBER 2, 1963, IN LEIPZIG. ORGANIZED BY THE INSTITUTE FOR PHYSICAL MATERIAL SEPARATION, LEIPZIG, OF THE GERMAN ACADEMY OF SCIENCES AT BERLIN. Muehlenpfordt, J.; Kretzschmann, G.; Wetzel, K. Abhandl. Deut. Akad. Wiss., Berlin, Kl. Chem., Geol. Biol., No. 7, 1-897(1964). (In German). (CONF-631007).

The 109 papers presented at the third work session on stable isotopes in Leipzig are compiled. The topics discussed include: separation of stable isotopes; analysis of stable isotopes; the uses of stable isotopes in biology, medicine, and agriculture; stable isotopes in organic chemistry; stable isotopes in inorganic chemistry and catalyst research; and isotope geology. (J.S.R.)

Industrial Applications

Refer also to abstracts 18247, 18248, 18277, 18298–18300, 18570, and 18950.

19121 (UH-235P5-1) DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUIT AND VEGETABLES BY GAMMA IRRADIATION. Annual Report, June 1, 1964–May 31, 1965. Akamine, E.; Brewbaker, J.; Cavaletto, C. (and others) (Hawaii Univ., Honolulu. Coll. of Tropical Agriculture). June 1965. Contract AT(04-3)-235. 78p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Separate abstracts were prepared for each of the seven sections in the report. (H.G.D.)

For abstracts of individual sections see: 18246–18248, 18298–18300, and 18950.

19122 CONTROL OF TOXOPLASMOSIS BY ^{60}Co GAMMA-IRRADIATION OF RAW MEAT. Tokutomi, Gojiro; Ikegami, Takeji (and others) (Inst. Public Health Tokyo). Bull. Inst. Public Health (Tokyo), 13: 253-7 (Dec. 1964).

Work was done to determine the lethal dosage of ^{60}Co γ-radiation to toxoplasma in intact brains of mice and in raw meat. Complete loss of infectivity to mice of RH strain was obtained when it was exposed to radiation dose of 11,100 rads. The Beverley strain cysts in intact brain were found to be more resistant. The lethal dose was estimated to be between 32,900 and 36,900 rads. Toxoplasma in raw meat was destroyed when exposed to approximately 20,000 rads. (TCO)

19123 RADIATION DISINFESTATION OF GRAIN—THE LAST 5 YEARS. Cornwell, P. B. (Rentokil Labs. Ltd., Eng.). Food Irradiat., 6: A2-A5(July-Dec. 1965).

Development of the program for radiation disinfestation of grain is reviewed. The events that have taken place over the past five years are surveyed as a background to the joint action now being taken by the IAEA and the FAO to establish a pilot plant for evaluating radiation disinfestation of grain as an industrial process in Turkey. It is concluded that at best radiation disinfestation is an additional insecticidal technique, which is never likely to replace present practices, but may be considered as an alternative where conditions are favorable for its application. (H.G.D.)

19124 USDA RESEARCH PROGRAM AND FACILITIES FOR THE USE OF GAMMA IRRADIATION IN THE CONTROL OF STORED-PRODUCT INSECTS. Laudani, Hamilton; Tilton, Elvin W.; Brower, John H. (Agricultural Research Service, Savannah, Ga.). Food Irradiat., 6: A6-A9(July-Dec. 1965).

A ^{60}Co food irradiator for grain disinfestation to be located at Savannah, Georgia, is described. The pilot plant, which will be operated by the USDA, will be located next to a railroad spur in an arrangement such as to permit continuous grain flow. Total activity of the ^{60}Co source will be about 26,000 C and capacity of the irradiator will be from 2500 to 10,000 pounds of grain per hr. In addition to bulk grain irradiation, packages and bags of a large range of processed agricultural commodities, including various cereals and grain products, dried fruit and nuts, and legumes may be processed in a separate section of the irradiator designed for package handling. Research will be oriented toward establishing: the minimum effective lethal dose for use in packaging plants where complete and immediate mortality of the insects is required; and the minimum effective dose to induce dominant lethal genes, thereby breaking the reproductive cycle of the insects. (H.G.D.)

19125 APPLICATION OF IONIZING RADIATION TO GRAIN DISINFESTATION. Goresline, Harry E. (Joint FAO/IAEA, Vienna). Food Irradiat., 6: A10-A12(July-Dec. 1965).

Genesis of a pilot plant in Turkey for the radiation disinfestation of grain is discussed. The installation will consist of a ^{60}Co irradiation unit of approximately 150,000 C located in an operating grain terminal as an independent unit that will not interfere with the normal operation of the terminal. The pilot plant will be used to study the effectiveness of grain radiosterilization under actual commercial conditions and to identify the problems that would be encountered in applying the method to all grain taken into a large operating terminal. (H.G.D.)

19126 IRRADIATION PRESERVATION OF PACIFIC COAST FISH AND SHELLFISH. IV. STORAGE LIFE OF DUNGENESS CRAB MEAT AT 33 DEG F (0.5 DEG C) AND 42 DEG F (5.5 DEG C). Miyauchi, D.; Spinelli, J.; Stoll, N.; Pelroy, G.; Eklund, M. (Bureau of Commerical Fisheries, Seattle, Wash.). Int. J. Appl. Radiat. Isotop., 17: 137-44(Mar. 1966).

Laboratory-scale studies were made to determine for fresh Dungeness crab meat the optimum radiation conditions directed toward defining commercial process parameters. Fresh crab meat was obtained from 4 different processing plants, packed in either C-enameled cans or in polyester–polyethylene pouches, irradiated at doses ranging from 0.1 to 0.5 Mrad with a ^{60}Co source, and tested for storage characteristics at 33 (0.5) and 42°F (5.5°C). Irradiation in the 0.1- and 0.2-Mrad range produced a freshlike product with a storage life 2 to 5 times greater than that of the unirradiated product; these low doses are therefore recommended for initial commercial application. Vacuum packing and nonvacuum packing in cans were equally effective in extending the shelf life of radiation-pasteurized crab meat. Storage life at 33°F (0.5°C) was almost double that at 42°F (5.5°C). (auth)

19127 HOMOGENEITY OF THE DOSE DISTRIBUTION DURING IRRADIATION WITH A 1-Mev ELECTRON ACCELERATOR. Gruenewald, Th. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kerntechnik, 8: 68-73(Feb. 1966). (In German).

The problem of the homogeneity of dose distribution during irradiation of foods with electrons was investigated. Measurements and calculations on the 1-Mev electron accelerator were carried out. General problems valid for this type of application of electron generators were derived with consideration of the soft and hard bremsstrahlung produced. (J.S.R.)

19128 III JUGOSLOVENSKI SIMPOZIJUM O PRIMENI RADIOAKTIVNIH IZOTOPA I ZRACENJA U INDUSTRIJI. (Third Yugoslavian Symposium on Use of Radioactive Isotopes and Radiation in Industry, Herceg-Novi, May 10–14, 1965). Belgrade, Savezna Komisija za Nuklearnu Energiju, Savezna Privredna Komora, [1965]. 550p. (CONF-650565).

Papers are presented on various subjects, including production of radionuclides and of neutron sources; radiochemical processes; and use of radionuclides in the machine industry, the petroleum industry, metallurgy, hydrology, and in hydroelectric plants. (IIC-MG)

19129 METHOD FOR PRODUCING SYNTHETIC PLASTIC PIPE JOINTS. Fujikubo, Sanshiro (to Hitachi Chemical Industry Co., Ltd.). Japanese Patent 1964-320. Jan. 9, 1965. Filed Jan. 21, 1963.

A new pipe-joint with improved electric, mechanical, and chemical properties is proposed. The outer surface of a joint, made of a crosslinkable thermoplastic material is crosslinked to a desired depth by irradiation with ionizing radiation. The most suitable material for the purpose is polyethylene with a density of 0.93–0.94 before the crosslinking. The joint of polyethylene with density 0.92 is destroyed after 4–6 minutes at 30°C at the inner pressure of 7.8 kg/cm^2 but the same joint with the density of 0.95 has a life of 100–200 hours under the same conditions. (NSA of Japan)

19130 METHOD FOR GIVING A PERMANENT SHAPE TO GLASS FIBER BY RADIATION. Fujisaki, Tatsuo (to Agency of Industrial Science and Technology). Japanese Patent 1964-1466. Jan. 27, 1965. Filed Feb. 6, 1963.

A method is proposed for giving a desired permanent shape to a glass or similar fiber, which has been shaped by a mechanical method, by irradiation of the fibers. This process improves the spinning property or bulkiness of the fiber. (TCO)

19131 HEATING AN UNDERGROUND RESERVOIR BY RADIOACTIVITY TO RECOVER VISCOUS AND TARRY DEPOSITS THEREFROM. Williams, Milton (to Esso Production Research Co.). U. S. Patent 3,233,669. Feb. 8, 1966. Filed Dec. 16, 1960.

A method of heating a petroleum reservoir to mobilize the petroleum consists of injecting into the petroleum deposit a clear radioactive solution and forming a radioactive precipitate in the deposit. When the petroleum is produced, the sand grains form an effective filter to prevent the radioactive material from being removed from the sand along with the petroleum. Preferably, the clear solution comprises an aqueous solution of an alkali metaphosphate into which is dissolved a salt, hydroxide, or oxide of a radioactive element selected from the group consisting of ^{85}Sr, ^{89}Sr, ^{90}Sr, ^{140}Ba, ^{41}Ca, ^{45}Ca, ^{141}Ce, ^{144}Ce, and mixtures of these. (B.L.M.)

Power Application

See also ENGINEERING — Space Propulsion

Refer also to abstract 20305.

19132 (N-65-24571) APOLLO EXTENSION SYSTEM STUDIES. STATE OF THE ART OF RADIOISOTOPE POWER SYSTEMS FOR LUNAR SURFACE VEHICLES. Breazeale, W. L. (Northrop Space Labs., Huntsville, Ala.). May 6, 1965. Contract NAS8-11096. 23p. (NASA-CR-61055). CFSTI $1.00 cy, $0.50 mn.

The development status of six radioisotope electric power systems suitable for operation on the lunar surface is investigated and discussed. The systems considered are a thermoelectric system, a thermionic system, a Brayton-cycle system, a Mercury-Rankine system, a Dowtherm-A Rankine System, and a Stirling engine. The applicability of these power systems to various lunar exploration concepts is discussed. All of the systems investigated are sufficiently advanced in technology to permit delivery of flight-rated systems within four years. Hence, these systems can be made available within the time frame planned for early lunar surface exploration. Information on isotope fuel forms was lacking, and recommendations are made to investigate this area. (STAR)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures

Refer also to abstracts 18804, 19312, 19885–19889, 20339, and 20340.

19133 (DUN-SA-4) A MODEL TO OPTIMIZE ^{238}Pu PRODUCTION BY FUEL RECYCLE. Nilson, R.; Showalter, C. W. (Douglas United Nuclear, Inc., Richland, Wash.). Feb. 15, 1966. Contract AT(45-1)-1857. 19p. (CONF-660305-17). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society Topical Meeting, Augusta, Ga.

The mathematical model encompasses both the production and economic aspects of increasing ^{237}Np production by recycling fuel. The incremental cost factors which are considered are cost of blend-up of the reactor tails to the initial fuel enrichment, cost to the reactor for the increased enrichment because of the ^{236}U introduced, and the difference in the feed material chain costs between recycling and not recycling, including interest charges on the fuel during

a storage period while it is waiting return to the reactor. (M.O.W.)

19134 (DUN-SA-5) OPTIMIZING ^{238}Pu PRODUCTION FROM IRRADIATION OF ^{237}Np. Meichle, R. H.; Owsley, G. F. (Douglas United Nuclear, Inc., Richland, Wash.). Feb. 25, 1966. Contract AT(45-1)-1857. 16p. (CONF-660305-16). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society Topical Meeting, Augusta, Ga.

The parameters involved in the production of ^{238}Pu from the irradiation of ^{237}Np in thermal reactors are discussed. Four independent factors strongly affect the production rate, conversion efficiency, and quality of ^{238}Pu from the irradiation of ^{237}Np. These are the neutron flux level, the neutron spectrum, the in-reactor residence for one cycle, and the out-of-reactor holdup time of the unconverted ^{237}Np prior to recharging in the reactor. These parameters are discussed. (M.O.W.)

19135 (K-C-718) BORON ISOTOPE SEPARATION STUDIES. Progress Report. (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 8, 1964. Contract W-7405-eng-26. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Developments are reported for: laboratory- and bench-scale studies of corrosion, solvent degradation, and any other factors of importance that might become apparent; engineering-scale test unit design, construction, and operation, and engineering studies, including conceptual design of a plant facility when adequate larger-scale data become available. Laboratory exposure studies in a glass system at about atmospheric pressure and temperatures ranging to 160°C indicated that nickel and stainless steels 304L and 316 should be satisfactory materials of construction. The most corrosive environment appeared to be in the high temperature gradient zone located between the sites where formation and decomposition of the boron trifluoride–anisole complex were proceeding rapidly. Resistance data for some nonmetallic materials are also given. Degradation products in the solvents from the various bench-scale tests were identified, and from these data mechanisms for the formation of the various products were formulated. The viscosity, surface tension, and density of the boron trifluoride–anisole complex were determined. Results obtained in operation of the bench-scale recombiner-decomposer system at pressures up to 40 psig are discussed. All equipment for an engineering-scale ANCO test unit was fabricated using stainless steel, and installation of the system is nearing completion. (P.C.H.)

19136 INVESTIGATIONS ON A NEW ISOTOPE GENERATOR FOR PRODUCTION OF ^{115m}In. Toerkoe, J. (National Atomic Energy Commission, Budapest). Atompraxis, 12: 97-9(Feb. 1966).

An isotope generator for producing carrier-free ^{115m}In from ^{115}Cd was developed. The parent element is adsorbed on a column filled with Dowex-1 × 8 and the ^{115m}In daughter milked daily over a 10-day period by using 0.15 n hydrochloric acid with an eluting rate of about 1 ml/min. A generator with an initial activity of 10 to 15 mC can be used for one week for the repeated production of carrier-free ^{115m}In with a radiochemical purity approaching 99.99%. (auth)

19137 PRODUCTION OF HIGH SPECIFIC ACTIVITY ^{114*}In PREPARATION. Saenko, L. F.; Egorov, A. I.; Ignatenko, E. I.; Moscalev, P. N. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1236(July 1965). (In Russian).

Two methods of preparing ^{114*}In sources of high specific activity, based on the recoil of the nucleus formed in the (n,γ) reaction, are described. The first involves irradiating permutit in indium form with integral fluxes up to 10^{19} n/cm^2; the enrichment coefficient by this method is equal to 3. The second method is the irradiation of indium phthalocyanine in an integral flux from 2×10^{18} to 8×10^{18} n/cm^2; the coefficient of enrichment varies from 10 to 30, depending on the integral flux. (M.J.T.)

19138 SURFACE DIFFUSION PHENOMENA IN GASEOUS DIFFUSION. III. ISOTOPE EFFECT ON SURFACE DIFFUSION FLOW. Higashi, Kunio; Oya, Akio; Oishi, Jun (Kyoto Univ.). J. Nucl. Sci. Technol., 3: 51-6(Feb. 1966).

The isotope effect on surface diffusion flow was estimated assuming that this flow originates in the hopping of adsorbed molecules, and the conclusion that surface diffusion flow in monolayer adsorption has an isotope effect comparable to Knudsen flow was obtained. Based on this conclusion, and applying a new model for surface diffusion proposed previously, isotope separation by gaseous diffusion in which Knudsen flow is accompanied by surface diffusion flow was analyzed. In addition to the theoretical treatment, experiments were performed on isotope separation under conditions of surface diffusion flow rate comparable to or a few times greater than that of Knudsen flow, and verified that the isotope effect on surface diffusion flow obeys the proposed theory. It was observed that the separation efficiency with the coverage (θ) around unity is much poorer than with low surface concentrations. (auth)

19139 PRODUCTION OF RADIONUCLIDES OF HIGH SPECIFIC ACTIVITY IN THE MOL BR 2 REACTOR. Hebel, W. (EURATOM, Mol, Belg.). Kerntechnik, 8: 78-80(Feb. 1966). (In German).

Formulas correlating the specific activity of isotopes and the irradiation time in the reactor were derived and applied to ^{192}Ir. Irradiation capsules for the Mol BR 2 reactor are described. The production of ^{60}Co is considered as a function of the cobalt charge, the proportion of price to specific activity, and total activity as a function of the Co charge. (J.S.R.)

19140 MULTI-ION SOURCE ELECTROMAGNETIC ISOTOPE SEPARATOR. Dunjic, B. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). Nucl. Instrum. Methods, 40: 309-17(Mar. 1966).

The possibility of using a magnetic analyzer with several ion sources is discussed. The magnetic field of this analyzer is homogeneous with a circular cross-section. Geometrical characteristics are given. (auth)

19141 ELECTROMAGNETIC ISOTOPE SEPARATORS AND THEIR APPLICATIONS. Proceedings of the International Conference, Aarhus, Denmark, June 14-18, 1965. Koch, J.; Nielsen, K. O., eds. Nucl. Instrum. Methods, 38: 1-325(1965). (CONF-650627).

Sixty-eight papers and four abstracts of papers are included. Separate abstracts were prepared for sixty-five papers; two papers were previously abstracted in NSA, see 19: 39370 and 42017. The paper not abstracted is a brief statement on scattering in double-focusing separators. (L.B.S.)

For abstracts of individual papers see: 18780, 18781, 19000–19004, 19142–19167, 19278, 19309, 19368–19373, 19884–19889, and 20121–20138.

19142 A THERMAL ION SOURCE FOR THE SEPARATION OF CESIUM BY THE ELECTROMAGNETIC ISOTOPE SEPARATOR AT ORSAY. Truong, M. (Faculte des Sciences, Orsay, France); Wotke, H. Nucl. Instrum. Methods, 38: 23-5(1965).

A description of a thermal ionization unit is given which can be inserted into the arc chamber of the usual high-temperature discharge ion source of the Orsay Isotope Separator. This system easily permits a transformation of the arc discharge ion source into a thermal ion source whenever it is advantageous. Data on the first results are given. (auth)

19143 ION SOURCES FOR FAST ELECTROMAGNETIC SEPARATIONS OF RADIOISOTOPES AND THEIR APPLICATION TO NUCLEAR PHYSICS. Sarrouy, J. L. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France); Camplan, J.; Dionisio, J. S.; Fournet-Fayas, J.; Levy, G.; Obert, J. Nucl. Instrum. Methods, 38: 29-36 (1965).

Three ion sources used at Orsay in the separation of stable and radioactive isotopes are described. Two of them are especially suitable for the rapid separation of short

lived radioisotopes, requiring for their evaporation only a moderate temperature but different mass marker substances. Their efficiency for the production of well focused ion beams of some stable elements attains values between 30% and 70%. The other ion source is used in the rapid separation of small amounts of radioelements widely disseminated inside solid materials with high melting points. It then requires a high temperature for their evaporation in the discharge chamber. Finally, a general survey is given of the studies made in nuclear spectroscopy and nuclear reactions with electromagnetically separated samples prepared with these ion sources. (auth)

19144 ION PRODUCTION AND BEAM FORMATION IN AN ELECTROMAGNETIC ISOTOPE SEPARATOR OF THE SECTOR TYPE. Chavet, I. (Institut du Radium, Orsay, France). Nucl. Instrum. Methods, 38: 37-40 (1965).

Following a systematic investigation of the numerous parameters of an electromagnetic isotope separator, a practical method was developed for controlling these parameters in order to obtain the optimum performance from the machine. During this study, a relation was found between the beam divergence and the extraction parameters. The conventional source was also investigated and was found to be capable of stable operation, yielding reproducible results and high efficiencies (68% for xenon and 42% for mercury). (auth)

19145 ISOTOPE CONTAMINATION AND ELECTROMAGNETIC SEPARATOR PERFORMANCE. Freeman, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods, 38: 49-55(1965).

In addition to covering the normal causes of contamination the concepts of self-contamination and parasitic contamination are reviewed. Such effects, which are trivial in routine separation, may be of considerable importance in ion-interaction studies and in radiochemical separator experiments. The additional problems that are likely to arise because of the present trend from μA intensities to higher ion beam intensities in experimental machines are also discussed. In conclusion some design and operational requirements to minimize contamination are considered. (auth)

19146 THE INFLUENCE OF GAS SCATTERING IN DIFFERENT REGIONS OF AN ISOTOPE SEPARATOR ON CONTAMINATION. Rautenbach, W. L.; Lubbinge, K. (CSIR, Pretoria). Nucl. Instrum. Methods, 38: 60-3 (1965).

The relative contribution of the interactions between ions and residual gases to the wings of mass lines at the collector of a laboratory isotope separator is studied for different regions of the flight path by varying the gas pressure in each region. The results show that the interactions in the collector region make by far the strongest contribution to the wings for a given increase in gas pressure. (auth)

19147 SOME MEASUREMENTS ABOUT RESOLUTION AND ISOTOPIC CONTAMINATION OF THE KARLSRUHE ELECTROMAGNETIC ISOTOPE SEPARATOR. Fabricius, H.; Freitag, K.; Goering, S. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods, 38: 64-8 (1965).

The Karlsruhe electromagnetic isotope separator is a 180° sector machine with an inhomogeneous magnetic field ($n = \frac{1}{2}$) and a mean radius of 102.5 cm. A Nielsen-type ion source was used with a maximum beam current of 500 μa. Measurements of the resolving power were made with Pb and Sb at different beam currents, different vacuum pressures, and different source exit apertures. At 0.1% of full line height a maximum resolving power of 1000 was obtained. ^{212}Pb was collected on a thin foil and the collector distribution of the α activity was measured. (auth)

19148 EFFICIENCY MEASUREMENTS OF THE ISOTOPE SEPARATION WITH A CESIUM ION SOURCE. Wagner, H. (Philipps-Univ., Marburg, Ger.). Nucl. Instrum. Methods, 38: 69-72(1965).

The radioactive cesium isotopes are to be separated for an optical determination of the isotope shift of the spectral lines. In order to reduce contamination, the losses in the different parts of the machine were investigated. By using a surface ionization source currents up to 12 μa at 20 kv were obtained at the collector with an overall efficiency up to 60%. (auth)

19149 MEASUREMENT OF THE ISOTOPE DEPOSIT DISTRIBUTION BY THE RADIOACTIVE TRACER TECHNIQUE. Perovic, B.; Jokic, T. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Nucl. Instrum. Methods, 38: 73-5(1965).

The results of a determination of the isotope deposit distribution on the collector of an electromagnetic mass separator is described. The distribution of the isotopic deposit on the target was examined by autoradiography using ^{131}Xe as a tracer. Aluminium targets were used and the ion energy was 15–40 kev. A pronounced effect on the isotope distribution in the target produced by the action of the neighboring isotopic beams, was observed. Some aspects of isotopic contamination are discussed. (auth)

19150 RADIOACTIVE TRACER TECHNIQUE FOR STUDYING THE COLLECTION OF STABLE ISOTOPES. Rautenbach, W. L.; Smith, H. J. (CSIR, Pretoria). Nucl. Instrum. Methods, 38: 76-8(1965).

By forming a hydride ion of an isotope of mass number A a radioactive isotope can in many cases be superimposed on a stable isotope of mass number A + 1 or A + 2 at the collector of an electromagnetic isotope separator. This method opens a wide field of application. The hydride formation in the case of krypton was investigated and used to study the collection of krypton on aluminium at energies of 40 and 5 kev. (auth)

19151 PREPARATION OF TARGETS WITH THE ELECTROMAGNETIC ISOTOPE SEPARATOR IN STRASBOURG. Gorodetzky, S.; Denimal, J.; Ricaud, C.; Rabin, B.; Armbruster, R. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods, 38: 79-81(1965).

Since September 1963 an electromagnetic isotope separator has been operated at the Institute of Nuclear Research. It is a one-stage Bernas type separator. Its main use is the preparation of targets. The isotopes are collected either on metallic foils, or on self supporting carbon films. In this latter case a retarding lens is used in order to collect at energies lower than 9 kev on films of 30 to 50 μg/cm^2 thickness. (auth)

19152 TECHNIQUES AND FEED MATERIALS WHICH HAVE IMPROVED CALUTRON PERFORMANCE. Newman, L. T.; Ennis, R. M.; Bell, W. A.; Veach, A. M.; Davis, W. C.; Spainhour, K. A.; Sheridan, C. W.; Love, L. O. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 38: 82-6(1965).

Electromagnetic isotope separations at Oak Ridge National Laboratory (ORNL) have been improved for a number of elements by more selective choice of charge materials, more precise vapor feed controls, more efficient pumping systems and more effective chemical trapping techniques in the collector. The use of special feed materials has resulted in increased outputs and higher isotopic purities for such elements as silicon, sulfur, ruthenium, tin and tungsten. An internally valved feed system has permitted the use of volatile fluorides of ruthenium and iridium in conventional sources and resulted in more successful separations at higher outputs. For some elements, particularly with isotopes of low abundance, losses from the receiver pockets due to the formation of volatile compounds by reaction with residual gases have been reduced by chemical pumping and use of different charge compounds. Chemical pumping has significantly reduced contamination of collected material by the normal element. New receiver concepts are being employed for collecting isotopes of high-vapor-pressure elements and are providing appreciable increases in isotopic purity. (auth)

19153 SPECIAL ORNL ISOTOPIC PREPARATIONS. Love, L. O.; Gwinn, H. R.; Alton, G. D.; O'Donnell, F. R.; McCombs, E. E.; Bailey, R. L.; Younghanse, J. O.; McDaniel, E. W. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 38: 87-90(1965).

Experiences in preparing ~10-g crystals of $^{48}CaF_2$ and >100-g cylinders of tungsten isotopes are given. The results of experimental ion collections on single crystals of copper and on various other substrates are presented. These collection techniques are applicable for preparation of specimens for diffusion studies, the formation of semiconductors, etc. Singly or doubly charged ions can be deposited with a considerable choice of ion velocity. In other preparations, actinide isotopes have been electrodeposited uniformly on a variety of metal forms. (auth)

19154 CONCEPTS IN DEVELOPING IN-PROCESS CALUTRON CONTROLS. Newman, L. T.; Bell, W. A.; Veach, A. M.; Shipley, E. D.; Gwinn, H. R.; Yonts, O. C.; Lee, J. V.; Love, L. O. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 38: 91-6(1965).

Methods of identifying problems occurring in the various steps of the electromagnetic separation of isotopes at the Oak Ridge National Laboratory (ORNL) have been developed. Most variations in isotopic purity can be traced to separator (calutron) performance, with only minor variations in purity introduced by chemical or mass analysis procedures. The contamination approach used to evaluate and interpret routine and experimental results has been programmed for use in computers. The knowledge of calutron behavior gained in this manner has been applied in efforts to improve the separation process and minimize the number of mass assays required. Experimental work toward stabilizing ion beams is described; however; the improved stability appears to be of value only in separating isotopes of the heavy elements. Simple techniques for detecting charge exchange, for studying changes in contaminating ion currents produced by experimental modifications and for evaluating charge recovery processes are described. (auth)

19155 SOME PERSPECTIVES IN ELECTROMAGNETIC ISOTOPE SEPARATION. Freeman, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods, 38: 97-102(1965).

Likely future requirements in design, to meet expected trends in the application of electromagnetic isotope separators, to research in specific fields of physics and chemistry are considered. Recent studies at Harwell on a small flexible separator system which might meet some of the anticipated requirements are described. (auth)

19156 THE ELECTROMAGNETIC ISOTOPE SEPARATOR OF THE LABORATORY OF NUCLEAR REACTIONS, JINR. Tarantin, N. I.; Demyanov, A. V.; Dyachikhin, Yu. A.; Kabachenko, A. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods, 38: 103-8(1965).

The calculation and the description of the mass separator of the LNR-JINR are reported. The mass separator is made on the basis of a commercially available electromagnet with magnetic shims at the entrance and at the exit of the analyzer. The mass separator is designated to analyze nuclear reaction products with mass number up to M = 260. The ion-optical characteristics of the mass separator and the experimental results in a ^{205}Tl and ^{203}Tl isotope separation are reported. (auth)

19157 MULTI-ION SOURCE ELECTROMAGNETIC ISOTOPE SEPARATOR. Dunjic, B. (Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia). Nucl. Instrum. Methods, 38: 109-12(1965).

The possibility of using a magnetic analyzer with several ion sources is discussed. The magnetic field of the analyzer is homogeneous with a circular cross section. (auth)

19158 OPERATING EXPERIENCE AND OPTIMIZATION OF A MASS SEPARATOR WITH REDUCED MAGNETIC FIELD VOLUME. Timpl, F. (Institut fuer Stabile Isotope, Leipzig). Nucl. Instrum. Methods, 38: 113-15(1965). (In German).

In order to exploit the advantages inherent in the medium-size electromagnetic isotope separators at the Institute of Stable Isotopes, which have a large beam-current and a high transmission due to beam-cross-over, and a reduced magnetic field volume, it is necessary to study the dependence of the two main characteristics, namely collector beam current and resolving power, vs the different operating variables. On the basis of this knowledge an exact optimization of operating conditions is possible. It is shown that the suitable selection of the arbitrary variables, e.g., the heating power of the furnace, arc chamber and cathode, plays a fundamental role for an economic operation. (auth)

19159 RECENT MODIFICATIONS OF THE ARGONNE SEPARATOR. Lerner, J. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 38: 116-20(1965).

Until recently, AREMIS (Argonne Research Electro-Magnetic Isotope Separator) was the only "Scandinavian-type" separator functioning in the United States. Because of the heavy demand for separator time it was desirable to develop techniques permitting maximum utilization of the machine and minimum "down-time"; reduction in cross-contamination between various separations was also of paramount importance. Among the modifications described are a compact and disposable quartz oven, a reliable and reproducible metering system for the gas oven, a reliable and reproducible metering system for the gas inlet to the ion source, an oscillating probe of improved sensitivity, a collection method for milligram amounts of gases and other materials of high vapor pressure and a versatile retarding system. (auth)

19160 ABERRATIONS IN A 255 DEG DOUBLE-FOCUSING SEPARATOR SUPPLIED WITH ONE AND TWO SOURCES. Trahin, M. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods, 38: 121-7(1965).

An electromagnetic double focusing separator (n = 0.5), was manufactured to produce isotopes in commercial quantities. An ion current of about 150 amp is drawn through a slit 12 cm wide by an accelerating voltage of 35 kv, with the radial and axial emission angles $\alpha_0 = \pm 0.15$ rad and $\beta_0 = \pi 0.03$ rad, respectively. Under such conditions, the ion beam spreads out on each side of the mean radius trajectory ($R_0 = 0.5$ m); this requires an accurate magnetic field of large volume for good transmission. For various field systems particle trajectories were numerically computed to obtain beam cross sections and to estimate the foci, aberrations and mass dispersion. Theoretical results are compared with experimental data. In order to increase the output of the separator, a modification producing simultaneous focusing for two concentric, separate ion beams is considered. A modified magnetic field was calculated to focus particles which are emitted from two ion sources with energies W_1 and W_2. Theoretical images of the foci, showing aberrations and mass dispersion, are shown as an application. (auth)

19161 DESIGN AND OPERATION OF A 24-INCH CALUTRON WITH SEVERAL MAGNETIC FIELD CONFIGURATIONS. Gilles, J.; Guibourg, J.; Swiners, B. (Compagnie Francaise Thomson Houston, Chatou, France). Nucl. Instrum. Methods, 38: 128-32(1965).

An electromagnetic isotope separator was designed and constructed with the aim to study several magnetic field configurations. The main steps were homogeneous field, linear shims and circular shims with an index $n = \frac{1}{2}$. It appears that cylindrical field symmetry offers considerable advantage as regards better focusing and increase of the transmission yield, allowing to separate more intense beams with a good enhancement factor and yield. (auth)

19162 THE COLUTRON MARK II, A VELOCITY FILTER ISOTOPE SEPARATOR. Wahlin, L. (Univ. of Colorado, Boulder). Nucl. Instrum. Methods, 38: 133-9(1965). (UCOL-535-549).

The Colutron Mark II is a portable, low intensity isotope separator. The separator which uses a velocity filter as analyzing system has adjustable dispersion, small size and a simple vacuum system as main features. Operating experience and a brief technical description of the velocity filter are given. A new beam scanning system and a high temperature ion source are also described. (auth)

19163 ON INHOMOGENEOUS MAGNETIC FIELDS FOR MASS SEPARATORS. Ruedenauer, F.; Viehboeck, F. P. (Reactor Center, Seibersdorf, Austria). Nucl. Instrum. Methods, 38: 140-3(1965).

Owing to their increased dispersion, mass separators with inhomogeneous magnetic fields may be useful for the production of highly enriched isotopes. As suggested by Boerboom and Tasman the required inhomogeneity may be obtained with conically shaped pole faces. It was shown that a tenfold increase in resolution, compared with a homogeneous field of the same mean radius may be achieved. The analytical treatment, however, only allows the calculation of aberrations for ions that travel along the mean radius. For simultaneous collection of more isotopes it would be important to know how the quality of focus varies with increasing distance from the mean radius. A numerical method is described which allows a three-dimensional ray-tracing through inhomogeneous magnetic sector fields. For several cases (one being the case of stigmatic focussing of the second order) the curve of direction focussing as well as the image shape along this curve is calculated. (auth)

19164 OPERATING EXPERIENCE WITH THE SEIBERSDORF INHOMOGENEOUS SECTOR FIELD ISOTOPE SEPARATOR. Formann, E.; Hechtl, E.; Lugmair, G.; Ruedenauer, F.; Viehboeck, F. P.; Wotke, H. (Reactor Center, Seibersdorf, Austria. Studiengesellschaft fuer Atomenergie GmbH, Vienna). Nucl. Instrum. Methods, 38: 144-7(1965).

The Seibersdorf Electromagnetic Isotope Separator has been used during the last 3 years for experiments requiring focused ion currents between 10^{-14} and 5×10^{-3} amp. The work in the low-current region concerned investigations on high temperature reactor fuel particles for nuclear spectroscopy. Targets of radioactive isotopes were produced using total ion currents in the order of 100 μamp. For neutron cross section measurements in the rare earth region stable isotopes were separated at ion currents up to 5 mamp. (auth)

19165 ORNL CALUTRON PROCESSING OF ALPHA-GAMMA MATERIALS AND STUDIES ON NEW SEPARATORS ADAPTABLE TO THIS PURPOSE. Love, L. O.; Prater, W. K.; Scheitlin, F. M.; Whitehead, T. W. Jr.; Dagenhart, W. K.; Tracy, J. G.; Johnson, R. L.; Banic, G. M. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods, 38: 148-51(1965).

Special equipment was designed at the Oak Ridge National Laboratory (ORNL) for the calutron processing of moderate quantities of α,γ-emitting materials. A 73-h run having an average ion output of 2.9 mamp provided 71 mg of 20.4% ^{242m}Am from an americium sample containing ~1% of the nuclide. Other elements that have been separated in the special electromagnetic containment facility at ORNL include plutonium, thorium and uranium. Some separations were made to reduce the unwanted isotope to the ppM- or ppB-level. (auth)

19166 PREPARATION OF RADIOACTIVE SAMPLES BY ISOTOPE SEPARATION. Nielsen, O. B. (Univ. of Copenhagen). Nucl. Instrum. Methods, 38: 312-3(1965).

This survey is based on information received from a large number of isotope separator laboratories in response to a request to supply data on their activities with respect to the preparation of radioactive source material for nuclear investigations since the Paris conference in 1962. Emphasis is put on the techniques used during the preparations. (auth)

19167 HOW NUCLEAR REACTION STUDIES CAN PROFIT FROM BETTER SAMPLES OF SEPARATED ISOTOPES. Elbek, B. (Univ. of Copenhagen). Nucl. Instrum. Methods, 38: 314-18(1965).

The rapid development of electrostatic accelerators and high resolution magnetic spectrographs has created an increased demand for thin targets with high isotopic and chemical purity. In relation to an outline of some of the more promising high resolution studies of nuclear reactions the requirements to such samples are discussed. It is concluded that the direct deposition of the target material on thin backings in a laboratory size electromagnetic isotope separator will meet most of the requirements. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 19839 and 19997.

19168 (AAEC/E-142) DEMON—A PROGRAMME GENERATOR FOR PROBLEMS INVOLVING ORDINARY DIFFERENTIAL EQUATIONS. Bennett, N. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1965. 210p. Dep. mn.

DEMON is a system designed to solve problems involving ordinary differential equations as quickly as possible. It accepts differential equations in the D–Notation (that is, $y'' = y + y'$ is expressed as D2Y = Y + DY), and generates a FORTRAN program to solve the problem. A means is provided for solving boundary equation problems. New integration methods may be defined to DEMON together with the problem. These methods may range from Predictor–Corrector to Gaussian quadrature. Non-self-starting methods are automatically started. The DEMON program was written in COBOL and should be suitable for any large machine. At the A.A.E.C. Research Establishment the DEMON system is working on a 32K IBM-7040, where the time taken from completely defining the problem to receiving the results may be as short as ten minutes. (auth)

19169 (BNL-929, pp 106-11) APPLIED MATHEMATICS. (Brookhaven National Lab., Upton, N. Y.).

Operation of the Central Scientific Computing Facility is summarized. Activities associated with computer research and development are reported along with programming for users of BNL computers. Research progress is reported on differential and integral equations, statistics, kinetic theory, and mathematical physics. (J.R.D.)

19170 (CEA-R-2927) CALCUL D'INTEGRALES DE QUELQUES FONCTIONS DE BESSEL. (Calculation of the Integrals of Some Bessel Functions). Gautier, Lucienne; Bardin, Christian (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 66p. Dep. mn.

The functions: $E_n(x) = \int_1^\infty (e^{-xt}/t^n)\,dt$, $K_{jn}(x) = (1/x^n)\int_0^x u^n K_0(u)\,du$, $K_{in}(x) = \int_0^{\pi/2} \sin^{n-1}\theta e - (x/\sin\theta)\,d\theta$, and $S_{mn}(\eta) = \int_0^{\pi/2} \cos^n\varphi K_{im+1}(2\eta\cos\varphi)\,d\varphi$ were calculated for all values of the variable and for a wide range of variation of the parameters, using methods which are described here. (auth)

19171 (COO-614-43) ICR QUARTERLY REPORT NUMBER 8. Miller, Richard H. (Chicago Univ., Ill. Inst. for Computer Research). Feb. 1, 1966. Contract AT(11-1)-614. 64p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Further research developments are reported on the Maniac III engineering activity, instructions, and the Man-Machine project. In addition, brief papers are presented on the following; syntactic analysis of ALGOL programs containing errors, matrix operations, construction of fixed points and solutions of nonlinear equations with demicompact mappings, and a large Michelson stellar interferometer. (M.O.W.)

19172 (IC-66/12) GENERAL EIGENFUNCTION EXPANSIONS AND GROUP REPRESENTATIONS. Lecture Notes. Maurin, K. (International Centre for Theoretical Physics, Trieste (Italy)). Feb. 1966. 14p. Dep. mn.

Results concerning a general theory of eigenfunction expansions for families of commuting self-adjoint operators in a separable Hilbert space are presented. The fundamental notion of the Hilbert-Schmidt (H-S) mapping is reviewed, and the definition of a nuclear space by means of H-S mappings is given. After other remarks on irreducible representations, it is shown that the irreducible spaces $H(\lambda)$ are common generalized eigenspaces of some self-adjoint operators constructed in a natural way. (M.O.W.)

19173 (UCRL-16481) TRIST—A TRILEVEL MULTIPROGRAMMING EXECUTIVE COORDINATING REAL-TIME PROCESSING OF DATA FROM AN ASYNCHRONOUS ON-LINE DEVICE WITH DATA ANALYSIS AND BACKGROUND PROGRAMS. Osborne, Carol; Larson, Robert; Oliver, Thomas; Pinchak, Joan; White, Howard S. (Lawrence Radiation Lab., Univ. of California, Berkeley). Oct. 26, 1965. Contract W-7405-eng-48. 17p. (CONF-660407-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Spring Joint Computer Conference, Boston.

TRIST is a trilevel multiprogramming executive designed both to coordinate computer operations with a real-time asynchronous device attached on-line to an IBM 7094 II and to make the computer time between real-time demands available for other uses. Although designed for these specific purposes, many of the ideas incorporated in the program are basic to any multiprogramming problem, and several of the special features included in the memory-protect routine, priority handling of subroutine use, loop and halt detection, and quality control are of particular interest. (auth)

19174 SPECIAL FUNCTIONS OF MATHEMATICAL PHYSICS FROM THE VIEWPOINT OF LIE ALGEBRA. Kaufman, Bruria (Weizmann Inst., Rehovoth, Israel). J. Math. Phys., 7: 447-57 (Mar. 1966).

Families of special functions, known from mathematical physics, are defined here by their recursion relations. The operators which raise and lower indices in these functions are considered as generators of a Lie algebra. The general element of the corresponding Lie group thus operates on the function in two ways: on the one hand it shifts the argument of the function; on the other hand it produces an infinite sum of functions (at the unchanged argument) with shifted indices. Equating the two results of the operation gives us "addition theorems," hitherto derived by analytical methods. The study is limited to 2- and 3-parameter Lie groups. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

19175 (ANL–6568) DIFFUSION IN GAMMA URANIUM. Final Report. Peterson, N. L.; Rothman, S. J. (Argonne National Lab., Ill.). Nov. 1965. Contract W-31-109-eng-38. 92p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The diffusion of Cr, Mn, Fe, Co, Ni, Cu, and Nb tracers in γ-U was measured by use of the thin-layer-sectioning technique. The plots of log D (the logarithm of the diffusion coefficient) vs 1/T (the reciprocal of the absolute temperature) are curved at low temperatures. The data do not agree quantitatively with any of the present theories of diffusion. A Kirkendall-effect experiment with a very slight concentration gradient showed that diffusion takes place by a defect mechanism. Preannealing a sample near the melting point, cooling to the diffusion temperature without going into the β-phase, depositing the isotope, and diffusing gave the same D as a conventional experiment, indicating that excess defects were not introduced by the $\beta \rightarrow \gamma$ phase transformation. Small additions of Co were shown to have a profound effect on self-diffusion in γ-U. These results can be explained only on the basis of the vacancy or interstitialcy mechanisms. (auth)

19176 (ANL–6975) VIBRATORY GRINDING AND POLISHING OF METALLOGRAPHIC SPECIMENS. Matras, S. (Argonne National Lab., Ill.). Nov. 1965. Contract W-31-109-eng-38. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The range of metallographic specimen preparation by vibratory polishing was extended to include the grinding operation. A controlled method was developed that reduces the metallographic grinding operation to essentially one step. This was achieved by: controlling the horizontal and vertical components of vibration by changing the springs and the weight of the bowl of the apparatus to conform to the specific requirements of grinding, and providing a special fixture that guides the specimen in a controlled and predetermined manner. The grinding fixture consists of a Lucite bowl that holds an 8-in.-dia. silicon carbide paper disc and a rotating turret in which the specimens are spaced and loaded with appropriate weights. The grinding produces specimens whose surfaces possess a minimum of disturbed metal with virtually no embedded abrasive. The specimens have flat surfaces and their edges are well-preserved. Inclusions and second phases, not normally in evidence at this stage of specimen preparation, are clearly delineated in the matrix. Retention of hard inclusions in a soft matrix is excellent. To achieve satisfactory surfaces, a final-polishing fixture utilizing a center-mounted, rotating carrier was devised. This fixture replaces the standard, stainless steel, polishing bowl and retaining ring. The fixture is mounted on a standard vibratory polishing unit. In contrast to standard vibratory polishing units that require specimen loadings of 300 to 600 g, the new device may be operated without any load on the specimen and will produce a superior polish. Preparing metallographic specimens now involves only three steps: specimen grinding on 400- or 600-grit silicon carbide paper, intermediate polishing, and final polishing. No more hand operations are necessary. The method has broad applicability. For example, it is routinely used for the specimen preparation of cermets, and high-purity thorium and thorium–plutonium alloys have also been successfully prepared. The technique is presently adapted to glovebox work for plutonium and its alloys, diffusion couples and alloys, and cermets that are difficult to prepare. (auth)

19177 (BMI–1757) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY, 1966. Keller, Donald L. (Battelle Memorial Inst., Columbus, Ohio). Feb. 1, 1966. Contract W-7405-eng-92. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Progress is reported in studies on fuels, reactor materials and components, uranium plutonium mononitride fuel materials, development of a portable smoke photometer, coated-particle fuel materials, and corrosion of the materials used in the fluidized-bed fluoride-volatility process. (W.L.G.)

19178 (IDO–17154) ANNUAL PROGRESS REPORT ON REACTOR FUELS AND MATERIALS DEVELOPMENT FOR FY 1965. Francis, W. C. (ed.) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Feb. 1966. Contract AT(10-1)-205. 138p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Progress is reported on developments in the uranium intermetallic fuel systems and on corrosion properties of several aluminum and aluminum–beryllium alloys. Microprobe examinations on irradiated and unirradiated fuel materials located fission products in fuel particles and matrix and were extremely helpful in evaluating fuel-matrix and fuel-cladding compatibility. The results of compression, impact and gas release measurements on beryllium irradiated at reactor ambient and at high temperatures are reported and compared with fractography studies. Fatigue studies on pressure vessel steels are summarized and the status is given on construction of an in-pile fatigue loop. The results are given of ultrasonic and metallographic examinations of a Fiberglas-fueled, aluminum-clad MTR fuel element. Developments in nondestructive testing, electron microscopy, fuel failure mechanisms, stress analysis, and prototypical irradiations are also reported. (auth)

19179 (N–65-21643) STUDIES OF TUNGSTEN COMPOSITES CONTAINING FIBERED OR REACTED ADDITIVES. Quatinetz, Max; Weeton, John W.; Herbell, Thomas P. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1965. 36p. (NASA-TN–D-2757). CFSTI $2.00 cy, $0.50 mn.

Twenty-one sintered tungsten and tungsten-plus-additive billets were prepared to evaluate the feasibility of producing fiber-bearing composites by the elongation of materials in situ (in a tungsten matrix) during extrusion, and to study reactions between the additives and the matrix with the objective of producing high-strength materials. Eight compounds, including oxides, borides, nitrides, and carbides, ranging in melting point from 4370 to 7030°F were successfully elongated in tungsten by extrusion at 4200°F. All composites with less than 10 vol % additive exhibited improvements in stress-rupture strength. Composites with highly elongated additives ranged from 4 to 18 times better in stress-rupture life at 3000°F than the unreinforced pure tungsten matrix. The stress-rupture lives of several composites with more reactive additives and only moderate fibering increased to 25 to 50 times that of tungsten at 3000°F. Because of inherent advantages, the in situ fibering method appears to have great potential for producing strong fibered composite materials and for producing fibers from strong, hard, and brittle refractory compounds and other relatively nondeformable materials. (auth)

19180 (NLCO–954) METALLOGRAPHY OF URANIUM: PROCEDURES AND STANDARDS. Cornett, M. H. (National Lead Co. of Ohio, Cincinnati). Mar. 25, 1966. Contract AT(30-1)-1156. 78p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Techniques for the preparation of uranium specimens so that their macro- and microstructures may be studied are presented. Included are procedures for sample preparation, etching, and photography. Also included are metallographic standards for the evaluation of the prepared samples with respect to grain size, recrystallization, and inclusion content. (W.L.G.)

19181 (SC-DC-66-1297) PERMEABILITY TECHNIQUES FOR CHARACTERIZING FINE POWDERS. Kaye, B. H. (IIT Research Inst., Chicago, Ill.). Feb. 9, 1966. Contract AT(29-1)-789. 46p. (CONF-660205-4). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, New York.

The physical significance of the so called "surface area" values deduced from permeability studies is discussed. The uses of permeability techniques in research and development of powder technology processes are outlined. The various forms of permeameter currently available are described. (auth)

19182 CERAMIC FUELS: URANIUM OXIDE. Bull. Inform. Sci. Tech. (Paris), No. 100, 7-28(Jan. 1966). (In French).

A process for preparing UO_2 suitable for industrial sintering, by continuous precipitation of ammonium uranate, calcination to U_3O_8, and continuous reduction to UO_2 by cracked ammonia in a rotating oven, was transposed to the pilot-plant scale. It was successfully tried out under industrial operational conditions which are described. The powder obtained is then sintered by a process already described; the optimum economic operational conditions for this process are discussed. The in-pile behavior of the sintered products is then studied, in particular from two very important points of view: the temperature distribution in the fuel and the production of gaseous fission products. (auth)

19183 USE OF MIXED URANIUM–PLUTONIUM CARBIDES AS FUEL FOR FAST REACTORS. Pascard, R. Bull. Inform. Sci. Tech. (Paris), No. 100, 41-56(Jan. 1966). (In French).

The possible use of mixed uranium–plutonium carbides as a fuel for fast reactors is examined, with special reference to difficulties arising from compatibility with the cladding and swelling properties under irradiation. A review of present knowledge concerning these two problems is given as well as possible solutions to improve the fuel properties of monocarbides. The general conclusion is that a change from pure carbides to oxycarbides or carbonitrides would offer the best chance of success. (auth)

19184 PHYSICO-CHEMICAL STUDIES ON URANIUM-BASE CERAMIC FUELS. Bull. Inform. Sci. Tech. (Paris), No. 100, 91-123(Jan. 1966). (In French).

The principal mechanisms leading to the expulsion of fission gases from a small isothermally irradiated UO_2 sample are reviewed. The gas production depends on the temperature only above 800°C and is then a thermally activated phenomenon whose activation energy depends on the density of the irradiated oxide. Furthermore, the development of production processes for ceramic fuel materials, as well as the prediction of their behavior in an atomic reactor, requires thorough knowledge of their physicochemical properties. In spite of the large amount of work carried out on ceramic compounds, especially uranium dioxide, many points still remain obscure and are the subject of discussion. This is particularly so in the case of the uranium–oxygen system, which is extremely complex. Similarly, the nature of the mechanism of the autodiffusion of uranium in the dioxide and the monocarbide will require the adoption of more precise methods than have been used in the past in order to be explained. Finally, results are given concerning research into the corrosion of uranium monocarbide in the conditions simulating those of can rupture. They show that oxidation, although pronounced, does not become catastrophic under these conditions. (auth)

19185 PREPARATION OF RARE EARTH METAL ALLOYS WITH TRANSITION METALS OF GROUPS VII AND VIII OF THE PERIODIC SYSTEM AS WELL AS WITH COPPER, SILVER, AND GOLD USING AMALGAMS. Kirchmayr, Hans Rudolf (Technische Hochschule, Vienna). Z. Metallk., 56: 767-70(Nov. 1965). (In German).

By a heat treatment of rare earth–Me-amalgams (ME = Mn, Fe, Co, Ni, Cu, Ag, Au), mercury-free rare earth–Me alloys can be prepared if the reaction between the components takes place not in liquid mercury, but after the mercury, which is bound in the RE–Hg compounds, is set free. Although higher temperatures than those used in the amalgam process are necessary, the advantages, e.g., the avoidance of the molten state and of reactions with the crucible, remain. The range of application of the method is illustrated with the aid of rare earth (Y, Sm, Gd, Dy, Ho, Er)–Me alloys. (auth)

19186 METHOD FOR THE ELECTROLYTIC POLISHING OF ZIRCONIUM, HAFNIUM AND THEIR ALLOYS. Sietnieks, Janis Alfreds (to Aktiebolaget Atomenergi). U. S. Patent 3,234,111. Feb. 8, 1966. Priority date Sept. 27, 1960, Sweden.

A method for electrolytic polishing of Zr, Hf, or alloys in which these elements constitute the major components consists of using the metal as the anode in a bath containing 200–400 g of NH_4F/l and about 200–400 g of NH_4NO_3/l with the total salt content of the aqueous solution being about 600 g/l. The bath is maintained at a temperature of approximately 30°C and at a pH of 6–8.4. The current density is maintained at 0.5–3 amp/decimeter^2 for from 4 to 10 min, and the object is continuously rotated slowly in the bath. (B.L.M.)

Corrosion

Refer also to abstracts 19135 and 20239.

19187 (BMI-1760) THE COMPATIBILITY OF URANIUM NITRIDE WITH POTENTIAL CLADDING METALS. Price, David E.; Moak, Donald P.; Chubb, Walston; Keller, Donald L. (Battelle Memorial Inst., Columbus, Ohio). Feb. 8, 1966. Contract W-7405-eng-92. 43p. (EURAEC-1591). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The compatibility of UN with stainless steel, Fe, Cr, Ni, Zircaloy-2, Zr, and Al was studied. Disks of UN and a metal were compressively loaded in contact at temperatures between 400 and 1350°C for periods of time up to 5000 hr. The reaction products that formed at the UN–metal interfaces were studied by metallographic examination, electron-beam microprobe analysis, x-ray-diffraction analysis, and hardness measurements. Observations made on Ni–UN, and Zircaloy-2–UN couples are correlated with hypothetical Ni–U–N and Zr–U–N phase diagrams. Reaction rates in UN couples with Cr, Ni, Zircaloy-2, and Zr were obtained by measuring the maximum thickness of reaction layers after heating for various times and temperatures. Heat treatments were carried out at 1000 to 1350°C for type 304 stainless steel, 700 to 1000°C for Fe, 800 to 1000°C for Cr, 600 to 1200°C for Ni, 600 to 900°C for Zircaloy-2, 600 to 700°C for Zr, and 400 to 600°C for Al. Reactions with limited amounts of excess nitrogen and oxygen present as an impurity were observed between UN and type 304 stainless steel, Fe, or Cr. (No reaction was observed between nitrogen and Fe.) More extensive reactions were observed between UN and Zr, Zircaloy-2, Ni, or Al in order of increasing reaction rates. (auth)

19188 (GEAP-5001) U. S.–EURATOM RESEARCH AND DEVELOPMENT PROGRAM. Final Summary Report, Project Agreement No. 39. Douglass, D. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct. 1965. Contract AT(04-3)-189. 87p. (EURAEC-1588). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

Transmission electron microscopy of the corrosion-oxidation films on Van Arkel Zr and Zircaloy-2, formed in air from 250 to 450°C and in water from 225 to 325°C, showed that gross differences existed in the film morphology depending upon the environment and surface preparation. Annealed Zr when oxidized in air formed mo-

noclinic zirconia films that replicated the metal grain structure, but which also contained fine-grain regions, pseudo-amorphous areas, pustules, and preferentially oxidized grain boundaries. Etched Zr, oxidized under the same conditions, formed uniform films having only one heterogeneity, preferentially oxidized twins. Oxidation of annealed Zr in water produced a high density of oxide nuclei (monoclinic oxide) on a single crystal monoclinic matrix. Longer oxidation produced pustules that were much more numerous than those formed by air oxidation. Some pseudo-amorphous areas were also observed, but the pustules appeared more important, and grew laterally to form a completely coalesced overgrowth. Zircaloy-2 generally formed more uniform films than Zr in air and in water, and did not exhibit the preferential grain boundary oxidation so prevalent in Zr oxidation films. Annealed Zircaloy-2 formed mottled films, whereas, etched Zircaloy-2 similarly oxidized, showed unmottled grains that were sharply delineated and which clearly showed local areas corresponding to the intermetallics. The intermetallic compounds, which were selectively etched in the metal, gave rise to small white islands in the oxide films. These areas were found by electron diffraction to be nearly structureless. Transmission electron microscopy of detached oxidation films on Ti showed that thin films of rutile formed initially of uniform thickness and replicated the metal structure. The replicated metal grains, hereafter called oxide grains, were either polycrystalline on thermally etched facets of the metal, or were pseudo-monocrystalline and consisted of low angle boundaries and subgrains. Subsequently, an overgrowth of rutile nucleated on the oxide grains. The overgrowth of single-crystalline, heavily microtwinned oxide, grew laterally and enclosed islands of matrix oxide, as well as inwardly, and consumed the initial film. Complete coalescence resulted in single crystal oxide grains corresponding to each metal grain. Two networks could be distinguished by contrast variations upon tilting. The first, which was most prevalent, nucleated within the oxide grains and only rarely crossed grain boundaries, whereas, the second nucleated at grain boundaries and grew across the grains. Oriented networks formed on faceted grains and grew along the faces rather than crossing ridges. Random networks were generally associated with pseudo-monocrystalline grains which formed on unfaceted metal grains. The characteristics of the matrix and the networks during heating are discussed, and the role of time and temperature on network nucleation and growth is considered. A few data points for oxygen-ion self-diffusion in UO_2 single crystals were obtained from 850 to 1000°C, but because of experimental difficulties, the reliability of the data is questionable. (auth)

19189 (N-65-21161) OPERATION OF A FORCED-CIRCULATION, CROLOY 9M, MERCURY LOOP TO STUDY CORROSION PRODUCT SEPARATION TECHNIQUES. Cooper, D. B.; Vargo, E. J. (Thompson Ramo Wooldridge Inc., Cleveland, Ohio). Apr. 1965. Contract NAS3-2538. 102p. (NASA-CR-217). CFSTI $4.00 cy, $0.75 mn.

A Croloy 9M, forced circulation, mercury loop was designed and operated for a total of 2918 hr at an average boiling temperature of 1074°F. Corrosion product separators were included in both the vapor and liquid sections of the system and were evaluated for their effectiveness in reducing problems associated with mass transfer in mercury systems. Corrosion data for this system were found to agree favorably with previously reported data for Croloy 9M. The separators in the vapor portion of the system removed 54.3% of the corroded metals found in the system, while the separator in the liquid region removed 24.7% of the corroded metals. Carbon diffusion was noted in the type 316 stainless steel-Croloy 9M composite tubing at temperatures above 1200°F. The diffusion of carbon from the Croloy 9M to the type 316 stainless steel resulted in grain coarsening of the Croloy 9M and a profusion of carbides in the type 316 stainless steel. The composite tubing also exhibited excessive creep after 2918 hr at 1405 ± 10°F, apparently a result of metallurgical changes in the type 316 stainless steel. Deposition and corrosive and/or erosive attack were observed, after 448 hr of loop operation, in a Croloy 9M throttling valve located at the superheater outlet. (auth)

19190 (N-65-22168) EFFECT OF LOW-DENSITY INERT GAS FLUSH ON OXYGEN–COLUMBIUM REACTION AT 1500 TO 2000 DEG F. Quarterly Report. (Aero Vac Corp., Troy, N. Y.). Dec. 1, 1964. Contract NASw-722. 9p. (NASA-CR-62343). CFSTI $1.00 cy, $0.50 mn.

The detectability of impurities was greatly extended; the sensitivity of the instrument, and maximum operating pressure, were both increased by one decade. These two factors, plus the reduction in background peaks due to ion-molecule interactions, increased the minimum detectable signal to approximately 20 ppB. It is felt that by purifying the gas to be analyzed to lower levels that are presently being obtained (100 to 1000 ppM), contaminants in the order of 1 to 10 ppB could be analyzed. Gas purification system analysis, present status, change over previous instrument, and potential improvements are discussed. Results to date with the gas analyses approach are summarized. (auth)

19191 (ORNL-TM-1430) SUMMARY REPORT OF THE REACTION OF STEAM WITH LARGE SPECIMENS OF GRAPHITE FOR THE EXPERIMENTAL GAS-COOLED REACTOR. Helms, R. E.; MacPherson, R. E. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Graphite reaction rates and hydrogen generation rates were determined for high pressure, high temperature steam flowing through a full-scale EGCR fuel element graphite sleeve (Speer 901-RYL), and a geometrically identical sleeve machined from EGCR moderator graphite (National Carbon Company). Graphite reaction rates were measured as a function of graphite burnoff in the temperature range of 1300 to 1600°F with both types of graphite. Exposure of the graphite to steam over a period of time increases the reactive surfaces area. This burnoff of graphite results in an increase in the nominal reaction rate. To determine the effect of pressure from 50 to 300 psig, test data were obtained using an EGCR fuel-element graphite sleeve. No significant effect of steam pressure on reaction rates was noted. (auth)

19192 (SC-DC-65-1918) STUDY OF THE CHEMICAL INTEGRITY OF RADIOISOTOPE CONTAINMENT MATERIALS IN LAUNCH ABORT ENVIRONMENTS. Summary Technical Report, Phase I. (TRW Systems, Redondo Beach, Calif.). Dec. 1965. Contracts AT(29-1)-789 and 4358,000. 68p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

For Sandia Corp., Albuquerque, N. Mex.

The detailed search and analysis of the available data from the literature to establish quantitatively what is known about the high temperature chemical interaction of radioisotope containment materials with launch pad abort combustion gas species are reported. The materials that were considered included cobalt-base alloys, nickel-base alloys, stainless steels, coated and uncoated refractory metals, and noble metal claddings. The high temperature interaction of these materials with the combustion gas species O_2, N_2, CO, CO_2, NO, H_2O, F_2, and HF forms the basis of this report. (auth)

19193 DEVELOPMENT OF OXIDATION-RESISTANT TUNGSTEN-BASE ALLOYS. White, J. E. (Aerospace Corp., El Segundo, Calif.). Contract AF 04(695)-469. AIAA (Amer. Inst. Aeron. Astronaut.) J., 4: 307-12(Feb. 1966).

Substantial improvement in the oxidation resistance of tungsten between 1600 and 3000°C has been obtained in an experimental evaluation of newly developed alloys containing refractory oxide particles or metallic elements, which form high melting oxides. Alloys studied contain one or more of the following additions: Ta, Zr, Th, ThO_2, Al_2O_3, or MgO. The additions of ThO_2, Al_2O_3, and MgO were limited to 10 vol %. All materials were produced by powder metallurgy techniques using fine elemental powders that yield homogeneous test bars on the order of 98% of theoretical density in the hot-pressed condition. Oxidation resistance was evaluated by measuring the surface recession rate on resistance heated 0.25-in.-dia bars in an air

flow of up to 136 fps. The Al_2O_3-bearing alloy exhibited the best oxidation resistance, which was nearly an order of magnitude better than that of pure tungsten up to 2500°C. A prominent fluxing action between the oxides of tungsten and ThO_2 or MgO resulted in a lower melting oxide, which was not as effective in inhibiting oxidation. Detailed metallographic and electron microprobe analyses were used to determine the uniformity and stability of the alloys at elevated temperatures, and x ray studies were conducted to help identify the complex oxide phases formed. (auth)

19194 USE OF THE SUPERHIGH-VOLTAGE ELECTRON MICROSCOPE FOR STUDYING SINGLE-CRYSTAL WHISKERS OF BERYLLIUM OXIDE. Budnikov, P. P.; Popov, N. M.; Sandulov, D. B. (Moscow Chemical Engineering Inst.). Dokl. Akad. Nauk SSSR, 164: 323-5 (Sept. 11, 1965). (In Russian).

Filamentary crystals of beryllium oxide were grown by high-temperature oxidation of metallic beryllium in an argon atmosphere containing 0.01% N and 0.003% O_2. The moisture content of the argon was 0.03 g/m^3 at 760 mm Hg. Oxidation was carried out in a quartz glass vessel for 24 hr at 1450 to 1500°C. A grayish white cottony mass was formed on the substrate in direct contact with the metallic beryllium. Microscopic analysis showed that this mass was made up of interwoven individual crystals of BeO from 1 to 10 to 15 mm in length. The grayish color was caused by the presence of small metal spheres on the ends of the filamentary crystals. In several cases, spiderlike formations were observed consisting of several whiskers attached radially to a single sphere. A superhigh-voltage electron microscope with an accelerating voltage of 400 kv (electron energy of 557 kev) was used for identification of crystals, determination of the direction of growth and diameter, and for studies by transillumination. Calculations made from point electron-diffraction patterns showed lattice parameters identical to those of beryllium oxide. The diameter of the BeO whiskers varied from hundredths of a micron to 4 to 5 μ. The diameter of the spheres on the ends of the crystals varied from 1 to a few dozen microns. The main direction of growth coincides with axes $[000\bar{1}]$ and $[10\bar{1}0]$. (CFSTI)

19195 ON THE CORROSION BEHAVIOR OF WELDED JOINTS FROM ZIRCONIUM ALLOYS WITH LOW NIOBIUM CONTENTS IN WATER AND STEAM AT ELEVATED TEMPERATURES. Spindler, H. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 679-84 (Dec. 1965). (In German).

Corrosion tests of welding joints from zirconium–niobium alloys containing up to 2.5% of weight of niobium in steam at 400°C and 120 atm as well as in water at 350°C and saturation pressure are described. The behavior of the different zones formed during the process of welding (welding zone, heat-affected zone, and non-affected basic material) was determined. The corrosion behavior of the zones mentioned pointed out to be strongly different from each other. Both the welding zone and heat-affected zone had been essentially more corroded than the non-affected basic material in steam at 400°C. The difference in the behavior of these zones increases with increasing content of niobium. Final annealing after welding at 700 or 585°C shifts the corrosion values of the zones nearer to each other. Annealing at 585°C leads to lower weight gain. ZrNb 2.5 in pressurized water at 350°C showed another behavior in that both the heat-affected zone and the welding zone had been corroded essentially less than the non-affected basic material. Final annealing leads to very similar corrosion behavior of all the zones. (auth)

19196 MEASURING METALLIC CORROSION BY RADIATION BACKSCATTERING AND RADIATION-INDUCED X-RAYS. Berk, Sigmund (Frankford Arsenal, Philadelphia). Mater. Protect., 4: 39-41(Nov. 1965).

A ^{147}Pm β-backscattering device was used to determine the relative amount of corrosion on metallic specimens. The method was found effective in measuring extent of oxidation or corrosion of nickel, niobium, and tantalum. The β-particle backscattering gage consisted of a methyl methacrylate sample and source holder mounted on a conducting Mylar window proportional counter. The source holder consisted of a methylmethacrylate block with a recessed cavity containing the evaporated ^{147}Pm solution and covered with a Mylar window 0.5 mm thick. Radioactivity of the ^{147}Pm ranged from 0.3 to 5.0 μC. The extent of backscattering from oxidized nickel was compared with thickness data for the nickel oxide films. The effect of oxidation time of the nickel squares by heating at 538°C on the amount of backscattering was examined. The count rate decreased from 0.5% for the specimen heated for one minute to 10.3% for the one heated for 20 min. β-particle backscattering was effective in detecting differences in the oxide coating or corrosion of the nickel specimens. The measurements were also useful in determining the length of time a metal has been heated at a fixed temperature or the maximum temperature to which a metal has been heated. The second method for measuring corrosion involved radioinduced x rays in the metal specimen. The principle involved is that on an uncorroded metal surface a maximum number of K_α x rays will be induced in a certain volume of the target by the radiation. However, if the same metal surface is then corroded, the volume increases because of migration of oxygen atoms into the metal. For brass specimens corroded by salt spray, the count rate for the Cu K_α x-ray production was 12% less than that obtained with the uncorroded brass. Using salt spray corroded steel, the iron K_α x-ray intensity was 6% less than that obtained with uncorroded steel. The results indicate that radioinduced x rays can be used to accurately measure the amount and type of corrosion. (BBB)

19197 THE OXIDATION OF TRANSITION METALS OF THE 4TH AND 5TH GROUPS OF THE PERIODIC TABLE BY WATER VAPOR AT LOW PARTIAL PRESSURE. Booss, Hans-Juergen. Z. Metallk., 57: 66-9(Jan. 1966). (In German).

The oxidation of zirconium, titanium, thorium, vanadium, and tantalum strips in water vapor of 8 and 1 torr, respectively, was examined. The oxidation of these metals was approximated by a parabolic law; tantalum only obeyed a linear law. Powders of these metals were also examined, and it was found that their oxidation behavior can be approximated mathematically, too. (auth)

Fabrication

Refer also to abstract 20228.

19198 (N-65-22107) PROCESS DEVELOPMENT AND EVALUATION OF PLASMA-SPRAYED BERYLLIUM. Roseberry, T. J.; Headman, M. L.; Parkinson, F. L. (Western Gear Corp., Lynwood, Calif. Research Dept.). Sept. 1964. 37p.

These investigations showed that plasma spray fabrication of thin-walled beryllium shapes is feasible. Dimensional stability and repeatability of the fabricated shapes using optimized techniques are high. As a result of employing a gas pressure densification technique, the following properties can be obtained: high strength—up to 67,000-psi U.T.S.; high density—between 98 to 99% of theoretical density; and completely isotropic grain structure with no preferred orientation due to fabrication. The nature of the fabrication process is such that the risk of contamination to both personnel and equipment is minimized. (auth)

19199 (RT/EL-(65)9) DEFORMAZIONI ELETTRODINAMICHE IN PROVINI A STRUTTURA CILINDRICA. (Electrodynamic Deformations in Cylindrically Shaped Samples). Conti, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 51p. Dep. mn.

By means of a high magnetic field, plastic deformations in conductors were obtained which are attractive because of mechanical characteristics and rapid operation. Results of experiments made on cylindrically shaped aluminum, SAP, copper, anticorodal and stainless steel samples are presented. A 4.8 kJ capacitor bank was employed. (auth)

19200 STUDY OF VACUUM ROLLING OF COLUMBIUM. Mal'tsev, M. V.; Dolzhenkov, F. E.; Sigalov,

Yu. M.; Volchek, F. R.; Bat, Yu. I. Sb. Tr. Ukr. N-I Inst. Metalloved., No. 10, 181-8(1964). (In Russian).

The main parameters of rolling Nb in vacuo and in air were studied over a wide range of temperatures from 300 to 1300°C. It was found that spread, coefficient of friction, and specific pressure in rolling Nb in vacuo are somewhat higher than when rolling in air. Spread basically occurred as a result of barrel formation and the transfer of metal from the lateral to the contact edges. Specific pressure depended to a slight extent on temperature in the range indicated. (Rev. Metal Lit.)

19201 A STUDY OF THE EFFECTS OF SPUTTERING PARAMETERS ON CONTINUOUSLY DEPOSITED TANTALUM NITRIDE FILMS AS PRESENTED AT THE OCTOBER 1965 ELECTROCHEMICAL SOCIETY MEETING IN BUFFALO, NEW YORK. George, C. H.; Woo, W. K. (Western Electric Co., Inc., Princeton, N. J.). 19p. (CONF-651017-8). ORAU. Gmelin, AED-CONF-65-289-8.

From Electrochemical Society Meeting, Buffalo.

The readily controllable and variable parameters for sputtering TaN films are the electric potential, current, degree of N_2 doping, chamber pressure, time, and preheat. Three parameters were selected for the study: electric potential, currrent, and N_2 doping. The thin film continuous vacuum processing machine, whose design resulted from the study, consists of a series of interconnected evacuated chambers. (W.L.G.)

Properties and Structure

See also CHEMISTRY — Inorganic and Physical Chemistry

PHYSICS — Solid State Physics

Refer also to abstracts 18570, 20185, and 20221.

19202 (AD-629571) THE THERMODYNAMICS OF THE ZIRCONIA/ZIRCONIUM-OXYGEN VAPOR SYSTEM. Krieger, F. J. (RAND Corp., Santa Monica, Calif.). Feb. 1966. Contract AF49(638)-1700. 36p. (RM-4907-PR).

Thermodynamic investigation of studies were made on zirconia, ZrO_2, over a range of temperatures up to 6000°K and pressures up to 10^3 atmospheres. Two sets of equilibrium composition equations were used; one representing a pure gas phase, the other a heterogeneous system of gas and condensed (i.e., solid or liquid) zirconia. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprised 5 gaseous zirconium–oxygen species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight or moles of condensed zirconia. (auth)

19203 (AECL-2528) AN EQUATION FOR CREEP OF COLD WORKED ZIRCALOY PRESSURE TUBE MATERIAL. Ibrahim, E. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Dec. 1965. 18p. Dep. mn. AECL $0.50.

Using the published results of Bell, an equation was derived for creep of cold worked Zircaloy-2 pressure tube material in the temperature range 300 to 450°C. This equation is:

$$\epsilon = 2.768 \times 10^{-5} e^{(1.5\,T\times10^{-3}+9.663\,\sigma\times10^{-5})} t^{(1.655\,T\times10^{-3}-0.297)},$$

where ϵ = strain, %; T = temperature, °C; σ = stress, psi; and t = time, hr. (auth)

19204 (EUR-2648.f) ESSAIS DE TRACTION A BASSES TEMPERATURES SUR SAP 4 PERCENT. (Tensile Tests at Low Temperatures on SAP 4 Percent). Boerman, D.; Debeir, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 1966. 14p. Dep. mn.

The application of a new cryostat, working with a gaseous phase in order to execute tensile tests between room temperature and −196°C, is described. As material SAP 4% was chosen. At the same time a new correction method was used so that the elastic modulus was obtained without using an extensometer. (auth)

19205 (GA-6923) A RESEARCH PROGRAM ON THE EFFECT OF SUBSTRUCTURE ON THE IRRADIATION STABILITY OF ASTM A302 GRADE B STEEL. Quarterly Progress Report No. 3. Trozera, T. A.; Flynn, P. W. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Jan. 24, 1966. Contract AT(04-3)-167. 13p. (EURAEC-1586). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Several specimens that received cold work and heat treatments in the region expected to result in optimum properties were tested. Tubular specimen fabrication and gauging problems appear to be solved. The radial strain extensometer was scaled up for use on tubes to be tested under biaxial stresses. Irradiation capsules were designed and component fabrication was started. (auth)

19206 (N-65-17331) RELATION OF LATTICE PARAMETERS TO FRICTION CHARACTERISTICS OF BERYLLIUM, HAFNIUM, ZIRCONIUM, AND OTHER HEXAGONAL METALS IN VACUUM. Buckley, Donald H.; Johnson, Robert L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1965. 15p. (NASA-TN-D-2670). CFSTI $1.00 cy, $0.50 mn.

The friction characteristics for three hexagonal metals (zirconium, hafnium, and beryllium) were determined in vacuum. The relation of these metals with crystal parameters and shear stress is discussed. Friction experiments were conducted with a hemispherical rider sliding on the flat surface of a rotating disk. The rider was loaded to 1000 grams, and experiments were conducted to surface speeds of 2000 feet per minute. Experiments were conducted with the metals sliding on themselves and on 440-C stainless steel. Zirconium and hafnium showed a decrease in friction with increase in sliding velocity, while beryllium exhibited an increase in friction coefficient with increase in sliding velocity. This relation can be related to resolved shear stresses and in turn to crystal lattice parameters. The decrease in friction characteristics with sliding velocity of zirconium can be related to lattice parameters. A general relation was found between 14 hexagonal metals and their crystal lattice parameters. (auth)

19207 (N-65-21346) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, September 1–30, 1962. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Hudson, R. G. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Contract NAS3-2532. 20p. (NASA-CR-57899; GACD-3760). CFSTI $1.00 cy, $0.50 mn.

An all-metal cell for testing the vaporization and emission of UC–ZrC and W-clad UC systems in the presence of Cs vapor is being fabricated. High temperature property studies include density effects on the rate of vaporization and electron emission of UC–ZrC in vacuum, fabrication of a cell for redeposition, and design of a thermionic emission microscope. A capsule for studying dimensional stability and fission gas release behaviors of UC–ZrC and W-clad UC upon irradiation at high temperatures is being designed. The $UMoC_2$ and UC–ZrC cathodic materials containing a small amount of Ce and Th carbides were prepared for vacuum emission study, and various techniques are being investigated for producing W-clad UC emitters. (STAR)

19208 (N-65-21347) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, October 1–31, 1962. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Hudson, R. G. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Contract NAS3-2532. 15p. (NASA-CR-57897; GACD-3825). CFSTI $1.00 cy, $0.50 mn.

Vaporization and emission tests of UC–ZrC and W-clad UC systems in the presence of Cs vapor and studies of high-temperature properties of UC–ZrC are being conducted. Work on fabricating an instrument panel for controlling capsule temperatures during irradiation was started. Also being investigated are emission and diffusion of new cathode materials. Carbide cathodes are

being fabricated by cold-pressing-sintering techniques, and cylindrical UC bodies are being clad with W by thermochemical decomposition. (STAR)

19209 (N-65-21348) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, December 1–31, 1962. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Hudson, R. G. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Contract NAS3-2532. 25p. (NASA-CR-57895; GACD-3960). CFSTI $1.00 cy, $0.50 mn.

Long-term tests of the vaporization and emission of UC–ZrC and W-clad UC in Cs vapor, and studies on the high-temperature properties of UC–ZrC, irradiation, and new cathode materials are reported. The cell for the vaporization of UC–ZrC in Cs vapor was modified to allow a thermocouple to stay in contact with the carbide sample surface during the run so that the pyrometer reading of the sample temperature can be checked. The modified cell was tested in vacuum. Also, the first cell for the study of emission stability of UC–ZrC and W-clad UC in Cs vapor was assembled and tested for thermal characteristics during vacuum operation. The cell operated successfully but developed leaks on cooling due to the overheating of the ceramic seal and brazed joints. Cooling fins were added to overcome these difficulties. The vacuum emission of UC–10ZrC, 86% dense was found to be lowered slightly, presumably due to excess metal removal in the sample by vaporization. (STAR)

19210 (N-65-21349) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, January 1–31, 1963. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Hudson, R. G. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Contract NAS3-2532. 25p. (NASA-CR-57898; GACD-4008). CFSTI $1.00 cy, $0.50 mn.

Rates of vaporization of UC–10% ZrC at a Cs pressure of 1.8 torr were measured. Cooling fans were added to critical areas of carbide cells being tested for emission stability. Porosimetric investigations for vacuum emission were made on various UC–ZrC samples, and physical redeposition studies using a UC cathode and Mo anode are being conducted. Emission patterns from a thermionic emission microscope are being correlated with patterns observed under an optical microscope. An unclad carbide capsule for irradiation was assembled, which had the configuration and shape of previously assembled clad capsules. Neutronic and heat-transfer data are being calculated. Various methods for fabricating clad carbide samples are given, and vacuum emission and vaporization rates were measured for new cathode materials. (STAR)

19211 (N-65-21350) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, June 1–30, 1963. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Horner, M. H.; Hudson, R. G. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Aug. 5, 1963. Contract NAS3-2532. 21p. (NASA-CR-57900; GACD-4457). CFSTI $1.00 cy, $0.50 mn.

Two cells, one containing a UC–70% ZrC sample and the other containing a UC–10% ZrC sample are in operation for vaporization testing in Cs vapor. Condensates from physical redeposition runs of UC, UC–70% ZrC and UC–10% ZrC cathodes vs Ni anode were analyzed for U and Zr contents. The poisoning and regeneration of the electron emission of a hyperstoichiometric UC sample show similarity between the emission pattern and microstructure of the sample. Hot cell examinations of samples in the unclad carbide capsule were started, and the clad capsule was irradiated in the reactor. The vacuum emission of a UC–70% NbC sample was measured and the vacuum rate of vaporization of a UC–70% TaC sample is in progress. Diffusion runs of Ir, Re, and W–26% Re vs hyperstoichiometric UC–70% ZrC were made, and diffusion-emission studies of vapor-deposited W-clad UC (4.70 wt-% C) and UC–70% ZrC samples are in progress. (STAR)

19212 (N-65-21351) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Informal Monthly Report, July 1–31, 1963. Yang, L.; Weinberg, A. F.; Carpenter, F. D.; Hudson, R. G.; Lindgren, J. R. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Contract NAS3-2532. 19p. (NASA-CR-57896; GACD-4508). CFSTI $1.00 cy, $0.50 mn.

Cells containing samples UC–70% ZrC and UC–10% ZrC operating for 294 and 335 hr, respectively, in Cs vapor at 1.8 torr pressure showed no appreciable effect of Cs vapor on the rate of vaporization. Measurements on the rate of vaporization of a UC–70% ZrC sample of better than 95% theoretical density are used to study porosity effects. Chemical redeposition studies using CaF additives are being initiated. Hot cell examinations of the contents of an unclad carbide capsule, the irradiation of a clad capsule for one cycle in GETR, and vacuum rate of evaporation studies of a UC–70% TaC sample were completed. Metallographic examinations on samples from a diffusion run of UC–70% ZrC vs. Ir, Re, and W–26% Re at 1800°C for 24 hr were made, and diffusion-emission studies of samples vapor-deposited, W-clad metal-rich UC and vapor-deposited, W-clad UC–70% ZrC are being continued. (STAR)

19213 (N-65-21739) THE TERNARY SYSTEM TANTALUM–HAFNIUM–CARBON AT 2050 DEG C. Deadmore, Daniel L.; Zaplatynsky, Isidor (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1965. 15p. (NASA-TN-D-2768). CFSTI $1.00 cy, $0.50 mn.

An isothermal cross section of the tantalum–hafnium–carbon system at 2050°C was constructed from x-ray diffraction, chemical analysis, metallographic, and microhardness data. No phases other than those appearing in the three binary systems were observed in the ternary system. A liquid phase was found in a large portion of the hafnium-rich corner of the ternary section. (auth)

19214 (N-65-22097) PROPERTIES OF HAYNES ALLOY Cb-753. Developmental Report. Schussler, M. (Union Carbide Corp., Kokomo, Ind. Stellite Div.). Mar. 1, 1965. 40p.

A new niobium-base alloy combining fabricability, weldability, and short-time strength properties was developed as a high-strength alloy to possibly replace niobium–1% zirconium, which has had extensive use in some nuclear reactor applications. Data on the properties of this alloy are summarized. The recrystallization temperature of cold-worked sheet and rod is about 2200°F. The microstructure consists of a matrix of niobium–vanadium–zirconium solid solution containing dispersed particles of ZrO_2 in two crystallographic forms. The alloy has excellent bend ductility, Olsen cup ductility, stress-rupture, and creep properties. Above 2000°F, the stress-rupture strength is not as attractive as that of niobium-base alloys containing tungsten. Also, the tensile properties appear quite attractive in the temperature range from room temperature to 2400°F. The alloy is metallurgically stable and weldments show good ductility at liquid nitrogen temperature. (STAR)

19215 (NASA-SP-5037) BIBLIOGRAPHY ON SOLID LUBRICANTS (WITH INDEXES). Technology Utilization Bibliography. (Indiana Univ., Bloomington. Aerospace Research Applications Center). Feb. 1966. 34p. CFSTI $1.00 cy, $0.50 mn.

References (86) with abstracts are given to reports and journals published from 1962 through 1964. The entries are listed according to corporate author. Separate author and subject indexes are included. (P.C.H.)

19216 (NP-15888) BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE. Volume 1965, No. 4, October–December 1965. Diamond, J. J. (ed.) (National Bureau of Standards, Washington, D. C.). 55p. NBS Free.

References (572) are given to journals published during 1965. The subjects covered include properties, reactions, and phase equilibria of materials studied, as well as de-

vices used in high-temperature chemistry and physics. (J.G.B.)

19217 (NP–15933) SOME THERMODYNAMIC PROPERTIES OF URANIUM, MOLYBDENUM, IRON, AND ZIRCONIUM AT HIGH TEMPERATURES AND PRESSURES. Marnell, P.; DeFelice, J.; Barker, J. (Nuclear Technology Corp., White Plains, N. Y.). Feb. 10, 1961. 32p.

For Allis-Chalmers Mfg. Co., Washington, D. C. Nuclear Power Dept.

Estimates of thermodynamic properties required in certain portions of the safety analysis of the Enrico Fermi Fast Breeder Reactor are presented. Specifically, estimates are obtained for the critical constants, pressure-volume-temperature relations, and heat capacities of U, Mo, Fe, and Zr. The methods used to generate these properties are discussed in detail. In addition, the properties of mixtures of the above constituents are considered. (auth)

19218 (NYO–2394-18) SOME ASPECTS OF THE FRACTURE OF METALLIC COMPOSITES. Technical Report No. 18. Gurland, J. (Brown Univ., Providence, R. I.). Feb. 1966. Contract AT(30-1)-2394. 25p. (CONF-660102-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 4th Symposium of Fundamental Phenomena in the Materials Sciences, Boston.

The fracture initiation and modes of failure of composites consisting of a brittle phase embedded in a ductile matrix are discussed. Factors contributing to crack initiation at reinforcing particles are residual stresses of thermal origin, elastic stress concentration, and plastic deformation. The fracture ductility of a particle-strengthened ductile metal is related to the particle concentration. Finally, the relative strengths of a brittle phase in bulk, as a bundle of fibers, and as embedded particles and fibers, are compared on the basis of statistical models of the state of aggregation and fracture mode. (auth)

19219 (RFP–691) LIQUID MEDIA FOR DENSITY MEASUREMENTS OF BERYLLIUM, PLUTONIUM, AND URANIUM. Elsheimer, H. N. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Feb. 25, 1966. Contract AT(29-1)-1106. 25p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An extensive literature survey was conducted to ascertain the optimum liquid media for determining the densities of beryllium, uranium, and plutonium. In conjunction with the literature survey, a limited amount of experimental work was done with Freon-113 fluorocarbon, a potentially useful immersion liquid for all three types of metals, especially beryllium. Successful application has been made of this particular compound for not only beryllium, but also plutonium. (auth)

19220 (RT/MET–(65)2) ESAMI STRUTTURALI SU ALCUNI TIPI DI SINTERIZZATI Al–Al_2O_3. (Structural Examination of a Few Sintered Al–Al_2O_3 Materials). Cabrini, A.; Fizzotti, C.; Franceschetti, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 30p. Dep. mn.

A few sintered Al–Al_2O_3 materials, containing up to 14 wt % alumina were examined. Structural properties of these products were investigated with special emphasis on preferred orientations, homogeneity of dispersed oxide, and type of alumina and inclusions present in these materials. The structural modifications originated by cold-working and annealing were further studied. The results obtained from high-temperature creep tests of specimens containing 7 wt % alumina are also reported. (auth)

19221 (TID–21670) YOUNG'S MODULUS OF LITHIUM BETWEEN 10 AND 300 DEG K. Snyder, Donald D.; Zimmerman, W. Bruce; Steinweg, Philip (Andrews Univ., Berrien Springs, Mich.). [1964]. Contract AT(11-1)-972. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Isotopically-enriched lithium (enrichment >99%) was extruded to form a cantilever beam, free at one end, which was vibrated transversely by an applied external a-c electric field. From the physical dimensions and the resonant frequency Young's Modulus was calculated for temperatures cycled from 300°K to 10°K and back to 300°K. Irreversible processes, such as large grain growth, occurring during the first cooling cycle give rise to a large hysteresis around the phase transition temperature which is essentially absent on subsequent cycles. A descriptive explanation is given based on similar, but displaced, curves for the two phases one of which is stable above the transition temperature (~73°K) and the other below. The onset of change from one curve to the other (and presumably one phase to the other) is observed at unexpectedly high temperatures. No appreciable isotopic effect on the modulus or phase transition was established. (auth)

19222 (TRG–Report–954) AN INVESTIGATION OF THE INTERCHANGE OF IODINE SPECIES UNDER ADVANCED GAS-COOLED REACTOR CONDITIONS. Hillary, J. J.; Taylor, J. C. (Reactor Group, United Kingdom Atomic Energy Authority, Sellafield (England)). 1966. 32p. Dep. BIS $0.80. HMSO 4s.

Experiments were performed with tracer ^{131}I released into gas either held in a hot steel pressure vessel coated with an organic base primer or passed through a similarly coated steel pipe. The subsequent iodine content of the gas was investigated. The results show that at 390°C in a CO_2–CO atmosphere in absence of air all the forms of iodine produced deposited rapidly, and the proportion found on particles depended on the presence of a source of aerosols. At lower temperatures deposition rates were reduced. Addition of air caused the release of some of the deposited iodine in the elemental form, which persisted as long as air remained. The rate of decomposition of methyl iodide in the absence of air was somewhat erratic, and appears to be very temperature dependent in the region 370–390°C. Long-term desorption studies show that iodine which continues to be released can vary in form under apparently similar conditions. When iodine desorbs into a gas stream in the range 20–300°C, from a pipe wall, the proportion of penetrating species (e.g., methyl iodide) formed increases with temperature. (auth)

19223 CRYSTAL STRUCTURE OF SOME ALKALINE EARTH METAL URANATES OF THE TYPE M_3UO_6. Rietveld, H. M. (Reactor Centrum Nederland, Petten, Netherlands). Acta Crystallogr., 20: 508-13(Apr. 10, 1966).

The compounds Ca_3UO_6 and Sr_3UO_6 are isomorphous and can be regarded as deformed substituted perovskite structures. They were refined by a full-matrix least-squares method using x-ray and neutron-diffraction powder data. The uranium atoms are surrounded by six oxygen atoms at an average distance of 2.13 Å. (auth)

19224 AB COMPOUNDS WITH Sc, Y, AND RARE EARTH METALS. II. FeB AND CrB TYPE STRUCTURES OF MONOSILICIDES AND GERMANIDES. Hohnke, D.; Parthe, E. (Univ. of Pennsylvania, Philadelphia). Acta Crystallogr., 20: 572-82(Apr. 10, 1966).

Twenty new rare earth silicides and germanides of composition AB were synthesized and their crystal structures determined. LaSi, CeSi, PrSi, NdSi, SmSi, GdSi, TbSi, DySi, HoSi, ErSi, LaGe, CeGe, PrGe crystallize in the FeB (B27) structure type. DySi, HoSi,ErSi, PrGe, NdGe, SmGe, GdGe, TbGe, DyGe, HoGe, and ErGe crystallize in the CrB structure type. Polymorphism occurs in DySi, HoSi, ErSi, and PrGe which crystallize in both of these structure types. The FeB- and CrB-type structures contain a common structural unit, the trigonal prism, which is stacked differently to form either structure. On this basis, a set of transformation equations relating the lattice constants of both structure types was derived. A survey of all known FeB- and CrB-type structures showed that these compounds occur only in two valence electron concentration ranges. The shape of the prism side within each range depends on the valence electron difference. (auth)

19225 STRUCTURES OF THE RARE EARTH GERMANIDES AT OR NEAR EQUIATOMIC PROPORTIONS. Tharp, A. G.; Smith, Gordon S.; Johnson, Quintin (Univ.

of California, Livermore). Acta Crystallogr., 20: 583-5(Apr. 10, 1966). (UCRL-14152(Rev.1)).

The rare earth germanides formed when the initial composition is equiatomic were surveyed. The results together with those in the literature furnish a fairly complete survey of the rare earth germanium compounds at or near equiatomic proportions. It was confirmed that CeGe crystallizes in the FeB structure type. The lattice constants obtained were: a = 8.356 ± 0.005; b = 4.084 ± 0.003; c = 6.041 ± 0.004 Å (λ = 1.54178 Å). The CrB structure type begins at PrGe and the results showed that this phase extends to Ho and probably to Er. About midway through the series, there appears a complex body-centered tetragonal phase. Crystals of this material were obtained from Gd through Lu. As noted, Gd, Tb, Dy, Ho, and probably Er also display a CrB-type monogermanide phase. (P.C.H.)

19226 STRUCTURE OF THE INTERMETALLIC COMPOUND Ce_3In. Dariel, M. (Nuclear Research Center, Negev, Israel). Acta Crystallogr., 20: 586(Apr. 10, 1966).

A chain of dry boxes under inert atmosphere was used in an attempt to identify the structures of the cerium-rich compounds of the Ce–In system. The structure of the alloys containing 25 at. % In (corresponding to the compound of formula Ce_3In) was found to be Ll_2 ($AuCu_3$ type) with a lattice parameter of 4.9610 ± 0.0005 Å. It was found, upon examination of the diffraction patterns of alloys having a higher indium content (up to 70 at. % In), that the compounds decomposed rapidly even in an inert atmosphere, giving a diffraction pattern which contained all the diffraction lines of pure metallic In, besides some additional faint lines that were not indexed. (P.C.H.)

19227 CONTRIBUTION TO A STUDY OF THE CRYSTAL STRUCTURE OF $LaAlO_3$. de Rango, C.; Tsoucaris, G.; Zelwer, C. (Centre National de la Recherche Scientifique, Bellevue, France). Acta Crystallogr., 20: 590-2 (Apr. 10, 1966). (In French).

The results of calculations made on $LaAlO_3$ by taking as hypothesis the least symmetrical group R3c are explained. A program for the IBM-7040 was used that permits the systematic exploration of a large number of structures by the simultaneous calculation of intensities of the lines of neutron diffraction diagrams and independent reflections of the x-ray diagrams. It was concluded that the experimental data were not sufficient to determine without ambiguity all the coordinates. Nevertheless the study permits the exclusion, in a certain manner, of a large number of structural models. (P.C.H.)

19228 COMPATIBILITY OF TANTALUM AND COLUMBIUM ALLOYS WITH HYDROGEN. Walter, R. J.; Chandler, W. T. (Rocketdyne, Canoga Park, Calif.). AIAA (Amer. Inst. Aeron. Astronaut.) J., 4: 302-7(Feb. 1966).

A program was performed to aid in ascertaining the feasibility of using a niobium alloy, B-66, and Ta-10W as regeneratively cooled nozzle materials in a hydrogen-fueled engine. Tensile tests conducted on specimens in a hydrogen atmosphere indicated that hydrogen reduced the ductility of B-66 and Ta-10W specimens at temperatures up to 800 and 400°F, respectively. Various coatings were tested as hydrogen barriers, and it was found that a tin–aluminum coating applied by Sylcor was nearly a complete barrier to hydrogen absorption between 800 and 1500°F. This coating, however, was not effective in preventing hydrogen embrittlement in tensile tests conducted at temperatures up to 400°F. When exposed to hydrogen, these metals were subject to continuous fragmentation at low temperatures if a new surface had been formed through crack formation. Qualitative thermal diffusion tests indicate that thermal diffusion of hydrogen will occur from high-temperature to low-temperature regions. (auth)

19229 THERMIONIC EMISSION PROPERTIES OF A LANTHANUM HEXABORIDE–RHENIUM CATHODE. Buckingham, J. D. (Edwards High Vacuum International Ltd., Crawley, Eng.). Brit. J. Appl. Phys., 16: 1821-32(Dec. 1965).

An experimental investigation of the thermionic emission properties of a rhenium tape coated with lanthanum hexaboride is described, and its usefulness as a low temperature emitter for demountable vacuum ionization gages and mass spectrometers is considered. Methods of preparation and processing are described and measurements of the Richardson emission constants are given. The poisoning of the emission by those gases generally found in vacuum systems was studied, and the extent to which the activity can subsequently be restored is described. Measurements were also made of the rate of evaporation of active material from the cathode surface. (auth)

19230 THE MARTENSITE START TEMPERATURE IN DILUTE ZIRCONIUM–NIOBIUM ALLOYS. Higgins, G. T.; Banks, E. E. (Univ. of Liverpool). Brit. J. Appl. Phys., 17: 283-4(Feb. 1966).

Values of the martensite start temperature reported by Stewart, Hatt and Roberts are considered in the light of results obtained for both the martensite transformation and the diffusional $\beta \rightarrow \alpha$ transformation in dilute zirconium–niobium alloys. It is concluded that low β-annealing temperatures can increase the critical cooling rate to the point where thermal arrests associated with the diffusion-controlled $\beta \rightarrow \alpha$ transformation appear above the true M_s temperature. Genuine values of the M_s temperature may be obtained by employing β treatments 100°C above the $\beta|\alpha + \beta$ phase boundary. (auth)

19231 THE CRYSTAL STRUCTURE OF POTASSIUM HEPTAFLUOROPROTACTINATE(V). Brown, D.; Smith, A. J. (Atomic Energy Research Establishment, Harwell, Eng. The Univ., Sheffield, Eng.). Chem. Commun., No. 21, 554-5(Nov. 10, 1965).

Single-crystal oscillation patterns and Guinier powder patterns showed the potassium heptafluoroprotactinate(V) lattice to be C-centered monoclinic with a = 13.94, b = 6.76, c = 8.24Å, β = 125.5°, and Z = 4. A c-glide was deduced from systematic absences and the space group $C2/c$-C_{2h}^6 was chosen. It was also found that each protactinium atom is surrounded by nine fluorines in an arrangement which may be idealized as a trigonal prism with three equatorial fluorines added. The PaF_9 groups are linked in infinite chains parallel to [001] by two-fluorine bridges. Positional and thermal parameters in K_2PaF_7 are tabulated. (P.C.H.)

19232 AN AUSTENITIC CAST STEEL FOR LOW TEMPERATURE APPLICATIONS. Miller, A. B. (Oxford Univ.). Cryogenics, 5: 320-4(Dec. 1965).

The Oxford N.I.R.N.S. liquid helium bubble chamber body and helium platform have been cast in a low carbon-chromium-nickel-manganese austenitic steel designed to operate between 4.3 and 2.5°K for long periods in a magnetic field. This material has been chosen because it shows no sign of austenitic to martensitic change under these conditions, its magnetic permeability coefficient μ = 1.008 at 4.2°K, and it has good mechanical properties at low temperatures. The 2.5°K and the 4.5°K stress-strain curves for small test specimens show that the ratio yield-tensile stress increases from about 0.50 at room temperature to about 0.65 in the 2–4°K region. The laboratory welding tests on a thick cast section with a welding rod of extremely low carbon content gave quite satisfactory results without preheating the base metal. (auth)

19233 HIGH-EFFICIENCY BETATRON DETECTOR WITH SCINTILLATION COUNTERS FOR CHECKING THICK WELDED SEAMS. Gorbunov, V. I.; Pokrovskii, A. V. (Tomsk Polytechnic Inst., USSR). Defektoskopiya, No. 5, 38-44(1965). (In Russian).

The results of tests under laboratory conditions of the betatron defectoscope with scintillation counters with high control efficiency (the area that can be scanned by the apparatus is 1000 to 1500 cm^2/min at thicknesses of welded steel up to 400 mm) were reported. Data on the determination of the sensitivity of the defectoscope and the selection of the optimum recording system were reported. (tr-auth)

19234 OXYGEN SELF-DIFFUSION IN URANIUM DIOXIDE. Thorn, R. J.; Winslow, G. H. (Argonne National Lab., Ill.). J. Chem. Phys., 44: 2822-3(Apr. 1, 1966).

The presence of a nonequilibrium, fixed distribution of uranium vacancies, determined by details of sample preparation, was previously assumed (J. Chem. Phys., 44: 2632(1966)). The argument that the energy required to remove an oxygen ion from a lattice site is less when the site borders a uranium vacancy was found to be compatible with the observed dependence of the diffusion constant on temperature near stoichiometry. Calculated and observed values of oxygen self-diffusion are presented as a function of temperature. (M.C.G.)

19235 DISCONTINUOUS MIGRATION OF JOINTS IN THE COURSE OF EXTREME GRAIN GROWTH IN α URANIUM. Dupuy, M.; Calais, D. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). J. Nucl. Mater., 19: 103-5(Apr. 1966). (In French).

During a study on the chemical diffusion of the homogeneous phase in the U–Pu system, it was shown that the migration of α-uranium boundaries was discontinuous during the extreme grain growth. A diffusion couple consisting of purified uranium and a monophase U–1% Pu alloy was annealed at 640°C. Alpha autoradiographs made at approximately 220 μm of the interface on the uranium side show an intergranular diffusion of the plutonium into the α-uranium. Figures are given to show the successive steps of the disappearance of a crystal at the expense of its neighboring regions. The plutonium diffuses preferentially into the uranium boundaries beginning from the collage interface. The discontinuous migration was due to a relaxation mechanism, which is discussed. (J.S.R.)

19236 THE USE OF LINEAR ANALYSIS FOR QUANTITATIVE STRUCTURE DESCRIPTION OF TUNGSTEN CARBIDE–COBALT ALLOYS. Exner, Hans Eckart; Fischmeister, Hellmut F. (Schwedische Institut fuer Metallforschung, Stockholm). Prakt. Metallog., 3: 18-27 (Jan. 1966). (In German).

The technique of preparation for electron microscope examination and the method for quantitative analysis of structure geometry of tungsten carbide–cobalt alloys are described. It could be shown that light microscopy gives considerable systematic errors because of the insufficient resolving power for structure elements below 1 μ. Some results of the electron microscopic structure analysis of WC–Co hard metals are given and some contradictions to literature data obtained by light microscopic examination are stated. (auth)

19237 PHOTOTHERMOELASTIMETRIC INVESTIGATION ON THE STRESS STATE IN THE NOTCH ZONE OF CIRCULAR PLATES WITH A CENTRAL HOLE AND OTHER PERIPHERAL HOLES REGULARLY SPACED, EXPOSED TO GIVEN TEMPERATURE DISTRIBUTIONS. Belgrado, M.; Guerrini, B.; Vigni, P. (Univ., Pisa, Italy). Riv. Ing. Nucl., 3: 695-714(Jan.-Apr. 1965). (In Italian).

By means of thermophotoelastimetric investigations the stress state in circular plates of constant thickness was determined with particular reference to the notch zone. The plates are characterized by the presence of a central hole on the border of which are notches and by other peripheral holes regularly spaced and exposed to a given temperature distribution. The plates having this geometric configuration are models of possible support lattices for the core of a nuclear reactor to be controlled by cruciform rods. The experimental values obtained, as a function of temperature, for the elastic modulus and the photoelastic constant of Araldit and the resin VP 1527 are reported. The results obtained from the photoelastimetric examination of the central hole are reported as a function of the theoretical stress that would be present on the border of the central hole in the absence of notches and peripheral holes. (tr-auth)

19238 CONSIDERATIONS ON THE THERMAL CONDUCTIVITY OF THE CONTACT BETWEEN SURFACES, WITH PARTICULAR REFERENCE TO THE CASE OF CLADDING-FISSILE MATERIAL IN A REACTOR FUEL ELEMENT. Matteuzzi, L. (CNEN-CSN, Casaccia, Italy). Riv. Ing. Nucl., 3: 721-30(Jan.-Apr. 1965). (In Italian).

From an analysis of the correlations proposed by various investigators for evaluation of conduction at a solid-solid contact, it was deduced that the Fenech-Rohsenow expression can be used in design studies. The use of such an expression implies measurement of the microhardness and the surface strength on the surface at contact. (tr-auth)

19239 VISCOSITY OF MOLTEN IRON WITH SMALL ADDITIONS OF LANTHANUM OR CERIUM. Romanov, A. A.; Kochegarov, V. G. Russ. Met. Mining, No. 6, 58-9 (1964).

Data on the activation energy, free energy, entropy, and concentration and temperature dependence of viscous flow of Fe–La (0.4 to 5% La) and Fe–Ce (0.2 to 5% Ce) solutions from 1500 to 1800°C were obtained. (Rev. Metal Lit.)

19240 EFFECT OF LANTHANUM, TIN AND CADMIUM ON THE RECRYSTALLIZATION OF MAGNESIUM. Fel'gina, S. B. Russ. Met. Mining, No. 6, 96-9(1964).

Separate alloying of pure Mg with La(0.1 to 2.7%), Sn(0.2 to 14.5%), and Cd(0.2 to 4.5%) and investigation of the alloys for recrystallization rate and terminal recrystallization temperature points from 100 to 450°C are reported. Recrystallization-concentration-temperature curves and constitutional diagrams for the alloys are presented. (Rev. Metal Lit.)

19241 EFFECT OF ZIRCONIUM ON THE MECHANICAL AND ELECTRICAL PROPERTIES OF ALUMINUM. Ageeva, I. N.; Grekov, N. A.; Zamotorin, M. I. Tr. Leningr. Politekh. Inst., No. 234, 69-74(1964). (In Russian).

Al alloys containing 0.35 to 0.95 Zr were tested in quenched and annealed states to determine the optimum Zr content to ensure good tensile and electrical properties. Alloying with 0.35% Zr increased the yield strength from 2 to 7.5 kg/mm^2, while 0.5% Zr produced a yield strength of 7.3 kg/mm^2 and an electrical conductivity 45% of pure Cu. On alloying with 0.95% Zr, a yield strength of 11.0 kg/mm^2, a tensile strength of 13.0 kg/mm^2, an elongation of 13%, and a reduction of area of 81% were observed. However, the relatively high Zr content adversely affected the conductivity. It was determined that a 0.5 to 0.7% Zr content produced the best tensile and electrical properties. (Rev. Metal Lit.)

19242 MEASUREMENTS OF THE SELF-DIFFUSION COEFFICIENT OF URANIUM HEXAFLUORIDE. Brown, M.; Murphy, E. G. (United Kingdom Atomic Energy Authority, Chester, Eng.). Trans. Faraday Soc., 61: 2442-6(Nov. 1965). (PG-Report-486).

Measurements of the self-diffusion coefficient of uranium hexafluoride were made at various temperatures in the range 0–70°C. The value reported by Ney and Armistead at 30°C is slightly higher. (auth)

19243 OXYGEN-ION CONDUCTING SOLID ELECTROLYTES AND POSSIBILITIES FOR THEIR APPLICATION. ON THE ELECTRICAL CONDUCTIVITY OF SYSTEMS OF ZIRCONIUM DIOXIDE WITH RARE EARTHS, PARTICULARLY WITH LUTETIUM AND SCANDIUM OXIDE. Moebius, H.-H.; Proeve, G. (Ernst-Moritz-Arndt-Univ., Griefswald, Ger.). Z. Chem., 5: 431-2 (Nov. 1965). (In German).

Mixtures of ZrO_2 and $LuO_{1.5}$ (15 to 60 mole %) or $ScO_{1.5}$ (15 to 60 mole %) were prepared and cooled slowly in a stepwise fashion under O_2. Conductivity was plotted for each of five mixtures in both systems as a function of temperature. At low concentrations of $MO_{1.5}$ distinct curvature in the functional relation was observed; this is probably due to the formation of overstructures. Formation of overstructures depended on composition and temperature and proceeded rapidly, giving irreproducible measured values. In the Sc system, disorder-order transformations were observed at 37 mole % $ScO_{1.5}$. Strong decrease in conductivity was first observed when the mixed phase border was passed at 60 mole %. In the Lu system temperature

curves were linear above 26% $LuO_{1.5}$; at high Lu concentrations the ordered phase develops with low conductivity probably in connection with the sintering process at high temperatures. (BBB)

19244 VAPOR PRESSURE MEASUREMENTS IN THE SYSTEM LEAD–THORIUM. Gans, Wigbert; Knacke, Ottmar; Mueller, Franz; Witte, Hartmut (Technische Hochschule, Aachen. Kernforschungsanlage, Juelich, Ger.). Z. Metallk., 57: 46-9(Jan. 1966). (In German).

From vapor pressure measurements using the Knudsen effusion method the values of the free energy of formation of intermetallic phases in the system Pb–Th were obtained for the temperature range from 600 to 1000°C: Pb + Th → ThPb, $\Delta G^0 = -19300 + 5.9 \cdot T$ cal; Pb + ½Th → ½$ThPb_2$, $\Delta G^0 = -16600 + 7.1 \cdot T$ cal; Pb + ⅓Th → ⅓$ThPb_3$, $\Delta G^0 = -15000 + 8.2 \cdot T$ cal; and Pb + ¼Th → ¼ $ThPb_4$, $\Delta G^0 = -13600 + 8.3 \cdot T$ cal. The temperatures of peritectic decomposition of $ThPb_4$ and $ThPb_3$ were determined to be 770 and 865°C, respectively. (auth)

19245 ON THE INTERPRETATION OF THE INGOT STRUCTURE OF THE Nb–Zr 25 ALLOY WITH LOW OXYGEN CONTENTS. Greiter, Veronika; Hauck, Dieter; Reinbach, Rudolf (Laboratorium der Vacuumschmelze AG, Hanau, Ger.). Z. Metallk., 57: 113-17(Feb. 1966). (In German).

The ingot structure of the Nb–Zr alloys solidifying as solid solutions, especially of the Nb–25Zr alloy is decisively influenced by two factors: primarily, by the solidification reaction in a temperature interval of more than 100°C with the subsequent formation of dendritic zone crystals; secondarily, by segregation in the solid state, which leads to the precipitation of oxygen-rich phases. Both reactions cannot be suppressed under the given melting and cooling-down conditions (electron beam or electric arc furnace) and are observed even on the cast samples containing the least amount of oxygen. The phases and structures thus formed are identified and interpreted. The results are presented comprehensively in a sectional view of the ternary diagram of Nb, Zr, and oxygen. (auth)

19246 ON THE CREEP BEHAVIOR OF URANIUM AND IRON UNDER DYNAMIC AND STATIC HEAT TREATMENT WITH SPECIAL CONSIDERATION OF THE POINTS WITH CHANGE OF PHASE. Scheiber, Sigismund; Stangler, Ferdinand (Univ., Vienna). Z. Metallk., 57: 135-40 (Feb. 1966). (In German).

The dependence of compression upon the number of cycles, the width of the temperature interval, the speed of temperature change, and upon the load applied was investigated on uranium and iron. For comparison, experiments at constant temperatures were carried out. The experimenting conditions were chosen in such a way that swelling was avoided as far as possible. With uranium no substantial difference in compression induced by dynamic or static heat treatment was found with the exception of the α-region and the vicinity of the α/β-change. It is possible to derive in a good approximation the behavior in the dynamic case from that in the static case. The γ-phase is found to be more compressible than the β-modification, and this again is more easily deformed than the α-phase. With iron the compressions are substantially larger following dynamic treatment than following static treatment with the exception of those in the γ-region. Practically it is only that part of the temperature cycle located in the α-region that is important for the extent of the dynamic deformation. The α-phase in the vicinity of the phase change turned out to be considerably more compressible than the γ-modification. This applies for the static as well as for the dynamic case. (auth)

19247 THE BINARY SYSTEMS CERIUM–ALUMINIUM AND PRASEODYMIUM–ALUMINIUM. Buschow, K. H. J.; Van Vucht, J. H. N. (N. V. Philips Gloeilampenfabricken, Eindhoven, Netherlands). Z. Metallk., 57: 162-6(Feb. 1966). (In German).

The aluminum-rich part of the cerium–aluminum system and the complete praseodymium–aluminum system were reinvestigated by means of metallographic methods, thermo-analysis, thermoresistometry and x-ray diffraction. Apart from the intermetallic compounds already known in these systems the existence of $CeAl_3$, Pr_2Al, and $PrAl_3$ is demonstrated. Pr_3Al is shown to undergo a transformation from the Ni_3Sn type (below 300°C) to the Cu_3Au type of structure (above 300°C). Crystal structures are also given for the compounds $CeAl_2$, $CeAl_3$, $PrAl_2$ and $PrAl_3$. The unit-cell dimensions are given for CeAl, α-$CeAl_4$, Pr_2Al, two types of PrAl and for α-$PrAl_4$. These results, together with those obtained by the metallographic and thermoanalytical methods are used to construct new phase diagrams for both systems. (auth)

19248 ISOTOPE EFFECT AT THE TRANSITION POINT STUDIED BY ZONE REFINING OF SOLID LITHIUM SULFATE. Lunden, Arnold; Svantesson, Erik; Svensson, Henry (Chalmers Inst. of Tech., Goteborg). Z. Naturforsch., 20a: 1279-82(Oct. 1965).

The technique of zone refining was applied at the transition point between α- and β-Li_2SO_4. The light lithium isotope is enriched in the direction of zone travel. The equilibrium distribution coefficient, k_0, is 0.996 for the two isotopic lithium sulfates. It is estimated that the transition point of $^6Li_2SO_4$ is about 0.7°C lower than that of $^7Li_2SO_4$. (auth)

19249 PHASE DIAGRAM IN THE Zr–ZrC SYSTEM. Vilk, Yu. N.; Ordanyan, S. S.; Avarbe, R. G.; Avgustinik, A. I.; Ryzhkova, T. P.; Omelchenko, Yu. A. Zh. Prikl. Khim., 38: 1500-6(July 1965). (In Russian).

A phase diagram, plotted on the basis of measurements of melting points and data from x-ray structural and metallographic studies in the Zr–ZrC system (in the range of 1.25 to 46.25 at. % C), was found to be eutectic in character. The temperature of the eutectic is 1820°C, and the eutectic composition contains 3.0 at. % carbon. The solubility of the carbon is about 2 at. % at the temperature of the eutectic transformation. The region of homogeneity of the ZrC phase at the temperature of the eutectic and at 1250°C is bounded by 35 and 39 at. % C, respectively. The lattice constant of alloys located in the two-phase region after soaking at 1400°C is equal to 4.653 kX; the extrapolated value of the lattice constant at the upper boundary of the region of homogeneity is equal to 4.688. The microhardness of alloys in the region of homogeneity of the ZrC phase and in the two-phase region is given. In accordance with a hypothesis advanced earlier, the microhardness of alloys may be extrapolated in a straight line to the value of microhardness for pure zirconium at zero carbon content. The solidus line extrapolated to the melting point of zirconium carbide reaches a point between 3375 and 3500°C, which also agrees with the data on the melting point of ZrC. (CFSTI)

19250 INTERNAL FRICTION IN DEFORMED MOLYBDENUM ALLOYS. Bronfin, M. B.; Marischev, V. A. pp 35-9 of Diffusion Processes, Structure, and Properties of Metals. New York, Consultants Bureau Enterprises, Inc., 1965.

The effect of grain size and temperature (20 to 1000°C) on the internal friction due to deformation was determined for sintered Mo and cast binary alloys of Mo containing 0.13% Zr and 50% Re, respectively. Impurities and the number of free dislocations had considerable effect on the observed maximum internal friction. No peak was found for the Mo–Re alloy from 20 to 700°C. It was therefore concluded that the mechanism of diffusion for this alloy differs considerably from the others, due to a lack of relatively free dislocations. (Rev. Metal Lit.)

19251 EFFECT OF INHERITED STRUCTURE IN MOLYBDENUM AND MOLYBDENUM ALLOYS. Bokshtein, S. Z.; Bronfin, M. B. pp 77-9 of Diffusion Processes, Structure, and Properties of Metals. New York, Consultants Bureau Enterprises, Inc., 1965.

Examination of recrystallized Mo and Mo–Zr alloy with ^{185}W as a radiotracer indicated grain boundaries migrate during diffusional annealing. Existence of an inherited structure corresponding to the grain boundaries existing before recrystallization, was confirmed. The inherited

structure was more defined in Mo–Zr alloy, due to a higher stability of structural defects at grain boundaries resulting from Zr carbides and oxides. (Rev. Metal Lit.)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry

19252 (BNWL-201) RADIATION-INDUCED DIMENSIONAL CHANGES OF GRAPHITES CONTAINING CARBON BLACK. Helm, J. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1966. Contract AT(45-1)-1830. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Samples of graphite were prepared that contained from 0 to 50% carbon black. At the higher fast neutron exposures, the graphites containing progressively smaller amounts of carbon black showed a progressively greater contraction in both the transverse and parallel directions. At the lower fast neutron exposures, the opposite behavior occurred. At the lower exposures, it appears that the carbon black causes the contraction to proceed so rapidly that the c-axis expansion of the crystallites becomes rate controlling, causing the decreased contraction rate. (W.L.G.)

19253 (CEND-3107-261) BURNABLE POISON ADDITIONS TO UO_2. Progress Report, October 1–December 31, 1965. Brayer, R. C.; Christopher, S. S. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Jan. 1966. Contract AT(30-1)-3107. 37p. (EURAEC-1592). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

A 6% enriched UO_2 fuel element, E-1, containing 500 ppm B_4C was fabricated at Combustion Engineering and was irradiated in the Saxton Reactor to a peak burnup of ~1070 MWD/MTU at a peak specific power of 17.2 kw/ft. A second rod, E-4, will be re-inserted in the Saxton Reactor during February and irradiated to a burnup of approximately 5000 MWD/MTU. Nondestructive evaluation of element E-1 was completed, and no defects or dimensional changes were found. The nondestructive evaluation included optical examination, dimensional analysis, gamma scanning, and plenum radiography. Sample locations for the destructive evaluation were established. The limits of accuracy and precision of boron analysis were established for both the 1-1′ dianthrimide colorimetric and mannitol titration methods. The effects of such variables as preoxidation, sample size, furnace loading temperature, type of boron compound and effect of contaminants were determined. (auth)

19254 (CONF-650629-3) A SMALL-ANGLE X-RAY SCATTERING STUDY OF RADIATION DAMAGE TO SILICA GELS. Larson, Bennett C.; Bale, Harold D. (North Dakota Univ., Grand Forks. Dept. of Physics). [nd]. Contract AT(11-1)-1255. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Conference on Small-Angle X-Ray Scattering, Syracuse, N. Y.

Four different silicon dioxide materials were pile irradiated to a fast neutron dose in excess of 10^{19} n/cm^2. In two of the samples irradiation produced a slight increase in the scattered intensity at the smallest angles and a decrease of intensity in the inverse fourth power region. The latter is attributed to a decrease in surface area for the sample. The coarsest gel studied showed very little change in the scattering curve after 1 week of irradiation, 2×10^{19} n_f/cm^2. The sample with the finest structure was very susceptible to irradiation effects. The mechanism of damage is discussed. Two different methods were used to calculate the surface areas from the x-ray data. (P.C.H.)

19255 (EUR-2749.e) TRAPPING OF KRYPTON IN URANIUM CARBIDE SURFACES. Gautsch, O.; Mustacchi, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Mar. 1966. 20p. Dep. mn.

The trapping of Kr in UC surfaces during neutron irradiation was investigated and about 10^{13} atoms of Kr were found embedded per cm^2 × atm of Kr after 5×10^{18} thermal nvt. Trapping of Kr was also observed in CaF_2 and Au which were thermally evaporated and recondensed in the presence of Kr. The Kr concentration in the recondensed layers was $2 \cdot 10^{-4}$ and $3 \cdot 10^{-5}$ atoms of Kr per atom of solid and unit Kr pressure, for CaF_2 and Au, respectively. (auth)

19256 (NYO-2024-9) RADIATION DAMAGE STUDIES IN SOLIDS USING THE TECHNIQUES OF ELECTRON-SPIN PARAMAGNETIC RESONANCE AND NUCLEAR MAGNETIC RESONANCE. Annual Progress Report, May 1, 1965–April 30, 1966. Bray, P. J. (Brown Univ., Providence, R. I. Dept. of Physics). Feb. 18, 1966. Contract AT(30-1)-2024. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

ESR studies were extended to K_a-band frequencies (35 Gcps) and to frequencies in the region of 350 Mcps. Investigations of the V-type centers in halide-containing glasses irradiated at room temperature were extended to glasses containing fluorine or iodine, and to specimens irradiated and studied at 77°K. Several new paramagnetic centers were discovered, and the relative abundances and hole affinities of the V-type hole traps and boron-oxygen hole traps were determined. Extensive studies of crystalline alkali borate compounds γ-irradiated at 77°K reveal the following points. The 5-line spectrum observed in the irradiated alkali borate glasses occurs for $Li_2O:4B_2O_3$ (the 1:4 compound). The 4-line spectrum found in glasses of high alkali content is produced in the 1:1 compound. A new 9-line spectrum is observed in the 1:2 compound. It is probable that the important structural groups appearing in the glasses are from the 1:4 and 1:1 compounds rather than the 1:2 compound. Models for two of the four paramagnetic centers discovered in the peroxyborates were formulated and substantially verified. Computer programs were used to generate resonance spectra for several paramagnetic ions subjected to various crystal fields. The observed spectrum for Mn^{2+} in polycrystalline $Li_2O:4B_2O_3$ was generated and large values found for the crystal-field coefficients D and E in the spin Hamiltonian. Extensive experimental and theoretical studies of the large hyperfine splittings found in a wide variety of phosphate glasses were completed. Previous investigators have failed to observe these strong resonances, or have identified them incorrectly. An intense spectrum observed in irradiated lead borate and lead silicate glasses was tentatively identified as an O^- center near a Pb^{2+} ion. Models for new spectra observed in irradiated boron oxide-silicon oxide glasses are being formulated. Work is in progress on other glass systems (e.g., alkali antimonate and alkali bismuthate glasses) and on compounds which may permit the accurate study in single crystals of spectra found in various irradiated glasses. (auth)

19257 (TID-22716) POST EXAMINATION OF UO_2–5 w/o PuO_2 FUELS. Ross, W. J.; Puechl, K. H.; Caldwell, C. S.; Miles, J.; Shipko, F.; Judd, W. C. (Nuclear Materials and Equipment Corp., Apollo, Pa.). [nd]. Contract AT(30-1)-3432. 3p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Irradiation exposures of 10,000 and 20,000 Mwd/tonne were obtained for coprecipitated and mechanically blended oxides sintered under dry reducing and under moist reducing atmosphere conditions. Intergranular metallic inclusions were observed in the dry-sintered specimens, but not in the wet-sintered. Central melting with equi-axed columnar grain growth occurred in the wet-fired specimens. No central melting was observed in other specimens subject to the same temperature conditions. Examination of specimens that contained prefired and green PuO_2 spherical particles showed that the spheres go into solid solution with the UO_2 matrix during irradiation. The green PuO_2 spheres went into solid solution more rapidly than the prefired spheres. (W.L.G.)

19258 (UJV-1470/65) VLIV NEUTRONOVEHO ZARENI NA MECHANICKE VLASTNOSTI NIZKOLEGOVANE OCELI TYPU 13030 MnNiMoNb. (The Effect of Neutron Irradiation on the Mechanical Properties of the 13030 Type (Mn Ni Mo Nb) Low-Alloy Steel). Vacek, M. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 37p. Dep. mn.

The effect of neutron irradiation on the mechanical properties of low-alloy pressure vessel steel was investigated. The extent of the radiation embrittlement of steel was determined according to an increase in the ductile-brittle transition temperature. By using five different impact samples the effect of specimen size and notch shape was evaluated. The tensile properties and hardness were measured simultaneously. The recovery of the radiation induced change in the mechanical properties as well as the effect of prolonged annealing (150 hr) at 350°C after irradiation was investigated. (auth)

19259 EFFECTS OF ELECTRON BOMBARDMENT ON THE OPTICAL PROPERTIES OF SPACECRAFT TEMPERATURE CONTROL COATINGS. Breuch, R. A.; Douglas, N. J.; Vance, D. (Lockheed Missiles and Space Co., Palo Alto, Calif.). AIAA (Amer. Inst. Aeron. Astronaut) J., 3: 2318-27(Dec. 1964).

Ten thermal control materials have been exposed in vacuum, at controlled temperatures, to a simulated geomagnetically trapped high-energy electron environment. The test parameters included a calculated mean electron energy of 0.80 Mev and total integrated fluxes of 10^{14}, 10^{15}, and 10^{16} electrons/cm^2. Sample temperatures were −180, +60, and +300°F. Optical damage spectra for the materials tested are reported, and mechanical damage is discussed. The behavior of optical properties after 485 sunhours of near-ultraviolet energy is presented for purposes of comparison. The extent of optical damage from electron bombardment ranges from an undetectable level to an increase in solar absorptance of more than 100% for the material systems tested. Selected materials exposed to electron fluxes and then subsequently exposed to an ultraviolet environment were damaged to more than an algebraic addition of the degrading effects of the two separate environments would predict. (auth)

19260 LATTICE DEFECTS IN ALUMINUM AND ITS ALLOYS. PART II. NEUTRON IRRADIATION AT -196C. Ceresara, S. Allumino, 34: No. 1, 9-12(1965). (In Italian).

High-purity Al, dilute binary Al alloys, and 10Zn−Al alloy were irradiated with neutrons at liquid N temperature. Lattice vacancies and interstitials produced by irradiation were eliminated by annealing. Two recovery stages observed, one at −150°C and the other at −60°C. The first recovery stage was greatly affected by impurities, while the second stage was dependent on activation energy, which was identical to the migration energy of single vacancies. (Rev. Metal Lit.)

19261 BLACKENING OF NATURAL QUARTZ BY γ IRRADIATION. Ritter, Charles J. (Univ. of Michigan, Ann Arbor); Dennen, William H. Amer. Mineral., 51: 220-8(Jan.-Feb. 1966).

Natural quartz of different geologic origin is blackened to different degrees and at different rates by γ-irradiation. These differences can be detected and semiquantitatively measured. Broad differences between the blackening of quartz from different environments may be of value in studies of provenance and the detailed differences between the quartz of similar environments may serve for correlation as well. (auth)

19262 CERAMIC FUELS: URANIUM CARBIDE. Bull. Inform. Sci. Tech. (Paris), No. 100, 29-40(Jan. 1966). (In French).

Uranium monocarbide was prepared on a pilot-plant scale in the form of bars which may be used in an ORGEL type reactor; the irradiation at low burnup thus obtained indicated that structural changes occurred connected with the length of time spent in-pile. (auth)

19263 DEVICES FOR IRRADIATION OF CERAMIC FUELS. Bull. Inform. Sci. Tech. (Paris), No. 100, 57-89 (Jan. 1966). (In French).

The necessity of carrying out experiments on fuels using high specific powers has led to the production of high temperatures in the samples which have subsequently to be lowered. Various irradiation devices are described that contain either little fuel cooled only by water circulation, or else greater amounts of fuel cooled by the water circulation of the reactor itself; in this latter case however, the sample is surrounded by liquid metal which facilitates heat transfer. It is also possible to make use of a thin gas layer, which acts as an adjustable thermal barrier. Finally, in the loops the fuel is maintained at a constant temperature by varying the flow of the pressurized carbon dioxide, which is itself cooled with the help of an exchanger. (auth)

19264 ADSORPTION UNDER IRRADIATION OF CARBON DIOXIDE ON ALUMINA. Coekelbergs, Roger; Crucq, Andre; Decot, Jean; Degols, Luc; Randoux, Michael; Timmerman, Lucien (Ecole Royale Militaire, Brussels). J. Chim. Phys., 63: 218-26(Feb. 1966). (In French).

Measurements were made of the initial rate of adsorption or desorption of CO_2 on alumina submitted to an irradiation by x rays (60 kev). Measurements were carried out at low pressure (0.4 torr) in the temperature range between 20 to 350°C. With regard to the effect induced by radiation three temperature ranges could be distinguished: from 20 to 150°C, reversible desorption; from 150 to 300°C, irreversible adsorption; and at higher temperatures, reversible desorption. Adsorption isotherms of CO_2 at various temperatures, as well as electric conductivity of alumina in the presence of CO_2, were also measured. These results can be explained within the frame of the electron theory of catalysis, by taking account of a phenomenon called "direct desorption" previously proposed in similar cases. (auth)

19265 BEHAVIOR OF TRITIUM IN ALUMINUM–LITHIUM ALLOYS. Shiraishi, Kensuke; Nagasaki, Ryukichi (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 499-505(Dec. 1965).

The behavior of radiation induced gas bubbles in Al−Li alloys was observed by means of ^3H autoradiography. The autoradiographs were compared with photomicrographs of the corresponding areas. Autoradiography proved to reveal the gas bubbles in the alloys more distinctly than photomicrography. It was found that the bubbles first appeared at the grain boundaries and subgrain boundaries, and there also appeared depleted zones along the grain boundaries. This was followed by crystallographic alignment of the bubbles when heated to higher temperatures. In the case of large gas concentrations, bubbles as large as 5 μ in diameter were observed in specimens heated for 1 hr at 500°C. Bubbles precipitated along the boundaries of recrystallized grains in a specimen of irradiated Al–2.7 wt. % Li when it was tension stretched and then heated for 1 hr at 300°C. (auth)

19266 CHANGES IN ELECTRICAL POLARIZATION OF HIGH POLYMERS FROM THE ACTION OF IONIZING RADIATION. PART II. PERMANENT CHANGES. Heyne, L.; Hauser, O. (Zentralinstitut fuer Kernforschung, Dresden). Kolloid Z., 206: 20-5(Nov. 1965). (In German).

The paraelectric susceptibility and dielectric constants were determined for polytetrafluoroethylene, polyethylene, polytrifluorochloroethylene, and polystyrene (and for comparison, the same parameters of some inorganic materials), before and one month after ionizing irradiation. The decrease of the paraelectric susceptibility of these high polymers caused by irradiation was less than the accuracy of measurement if only a small irradiation dose was used. The time of decrease varied from days to weeks. A strong permanent increase up to 10^6 and more of the paraelectric susceptibility remained after high irradiation doses. In some instances most of this permanent increase was produced after irradiation only during a time interval up to a few weeks. This phenomenon is attributed to stable changes of the structure of the molecules. As a result of its increase the paraelectric susceptibility becomes the determinant term of the permittivity, relative to its value and to its time dependence. Before irradiation, the paraelectric component of the permittivity was negligible in all the materials examined. The time dependence of the electric conductivity of second kind is in agreement with the formula of Schweidler in most cases after the irradiation with high doses, as before irradiation. (BBB)

19267 ANNEALING OF RADIATION DAMAGE IN BODY CENTERED CUBIC METALS AFTER NEUTRON IRRADIATION AT 4.5 DEG K. Burger, G. (Technische Hochschule, Munich); Isebeck, K.; Kerler, R.; Voelkl, J.; Wenzl, H.; Kuhlmann, H. H.; Schultz, H. Phys. Lett., 20: 470-2(Mar. 15, 1966). (In German).

The annealing stages for W, Ta, Nb, and Fe were determined between 5 and 420°K by means of residual resistance measurements. (tr-auth)

19268 INFLUENCE OF OXYGEN CONCENTRATION ON THE LOW-TEMPERATURE ANNEALING OF TANTALUM AFTER NEUTRON IRRADIATION AT 4.5 DEG K. Burger, G. (Technische Hochschule, Munich); Isebeck, K.; Kerler, R.; Volkl, J.; Wenzl, H.; Kuhlmann, H. H.; Schultz, H. Phys. Lett., 20: 472-4(Mar. 15, 1966). (In German).

The two lowest resistance-annealing stages of tantalum (9 and 15°K) were noticeably reduced by low oxygen concentrations (10^{-4} and 10^{-3} atomic percent). The damage rate was found to increase somewhat with increasing oxygen content. (tr-auth)

19269 THE EFFECT OF PROTON IRRADIATION AT LOW TEMPERATURES ON THE RESISTANCE OF α-MANGANESE. Mendelssohn, K.; Wigley, D. A. (Clarendon Lab., Oxford). Phys. Lett., 20: 483-5(Mar. 15, 1966).

The resistance of α-manganese was investigated as a function of temperature during and after proton irradiation at ~30°K. Its behavior shows certain similarities to that of plutonium, indicating that the latter may, like managanese, exhibit spontaneous magnetic ordering. (auth)

19270 A DETERMINATION OF THE THRESHOLD ENERGY FOR THE PRODUCTION OF RADIATION DAMAGE IN GOLD [Thesis]. Minnix, Richard Bryant. Chapel Hill, N. C., Univ. of North Carolina, 1965. 65p.

A study of the production of radiation damage in pure gold was carried out using electrons in the energy range from 1.3 to 2.0 Mev. The experimental damage production rate in thin gold strips was measured as a function of the incident electron energy. These data were compared with theoretical cross sections numerically calculated from the Mott theory for different assumed threshold displacement energies, T_d. The best fit to the data occurred for $T_d = 32$ ev. The resistivity of a unit concentration of Frenkel pairs was computed as $\rho_f = 0.49 \times 10^{-4}$ ohm-cm. It was concluded that the discrepancy between this value and theoretical predictions of $\rho_f \approx 3.00 \times 10^{-4}$ was due to the importance of directional effects in gold. This conclusion is supported by the results of recent sputtering experiments with gold. A meaningful value of ρ_f cannot, therefore, be stated without more knowledge of the probability-of-ejection function and its directional dependence. (Dissertation Abstr.)

19271 ACTIVATION AND SINTERING BEHAVIOR OF CALCIUM OXIDE—THE EFFECT OF COPPER X-IRRADIATION ON THE SURFACE AREA OF THE OXIDE PRODUCED BY THERMAL DECOMPOSITION. Mikhail, R. Sh. (A'in Shams Univ., Cairo). 21p. (CONF-651006-3). ORAU. Gmelin, AED-CONF-65-342-1.

From American Society for Testing Materials, 5th Pacific Area National Meeting, Seattle.

The thermal decomposition of a parent material presents a common tool in the preparation of active solids, mainly oxides. In lime-burning practice several factors are now known to affect the activity of the produced oxide. Among these factors are: the structure of the initial material, temperature and duration of calcination, and the presence or absence of air during decomposition. The present investigation deals with a new factor that may appreciably affect the activity of the produced oxide, namely the effect of copper x-irradiation. Copper x-irradiation of the parent material did not cause any variation of the surface area of the starting material or its decomposition products. But the irradiation of the partially or the completely dehydrated products resulted in measurable changes of the surface area. These changes were traced for products heated under vacuum at different temperatures for fixed durations, and for products heated at constant temperatures for various durations. For products heated for a fixed duration of heating at different temperatures, all specimens show a tendency for loss of area upon irradiation. Both the irradiated and unirradiated specimens given an area-temperature of decomposition curve characterized by a maximum, but this maximum is more sharp and is shifted to lower temperatures in the case of the irradiated specimens. Irradiation seems to well assist in reducing high area solids and activate the process of sintering. The effect of variation of duration of heating at a fixed temperature on the surface area show measurably higher areas for the irradiated than unirradiated specimens for incompletely decomposed samples. As decomposition approaches completion the effect is reversed and the irradiated products show smaller areas than the corresponding unirradiated samples. The results were discussed mainly to show the effect of irradiation on the different stages followed by a solid during thermal decomposition; these stages are dissociation, recrystallization, packing, and finally sintering, and a possible interpretation is presented. (auth)

PHYSICS

General

Refer also to abstracts 18559 and 20177.

19272 (AECL–2531) ELECTROMAGNETIC FIELDS ASSOCIATED WITH THE INITIATION OF CURRENT BETWEEN PARALLEL PERFECTLY CONDUCTING PLANES. Lee-Whiting, G. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jan. 1966. 22p. (FSD/ING–33). Dep. mn. AECL $1.00.

The transient electromagnetic field associated with the sudden initiation of a uniform and steady current throughout a right circular cylindrical region between a pair of parallel perfectly conducting planes is calculated. The flow of energy is discussed. (auth)

19273 (BNL–929, pp 3-43) PHYSICS. (Brookhaven National Lab., Upton, N. Y.).

Research efforts devoted to particle physics, atomic and molecular physics, neutron physics, nuclear structure, and solid state physics are summarized. (J.R.D.)

19274 (N–65–16830) THE EXPLICIT SOLUTION OF THE ANALYTIC N-BODY PROBLEM. Rauch, L. M. (Seton Hall Univ., South Orange, N. J.). [1963]. 33p. (NASA-CR–53213). CFSTI $2.00 cy, $0.50 mn.

The n-body problem is solved in an explicit form in essence, the resolution consists of two phases: to unfold the coefficients of the formal series, representing the solution, as functions of the initial conditions, and to show the existential validity of this formalistic solution of the nonregularized [6, 10] system of equations of motion. To develop these processes in the solution of the problem, general formulas are derived connecting the parameters in the equations of motion; a set of complexes are associated in the solutions involving the parameters with the coefficients of the formal time series; the recursive expressions of the coefficients are reduced to an irreducible recursive relation; and the region in which the formal time series represents the solution of the nonregularized n-body problem is specified. (STAR)

19275 ENERGY CONSERVATION AS THE BASIS OF RELATIVISTIC MECHANICS. [PART] II. Ehlers, J. (Southwest Center for Advanced Studies, Dallas); Rindler, W.; Penrose, R. Contract AF 33(615)-1029. Amer. J. Phys., 33: 995-7(Dec. 1965).

From the relativity principle and the conservation of energy in particle collisions the form of the energy function, and the conservation of inertial mass and three-momentum are deduced. It is shown that the arguments are parallel under Einsteinian and Galilean kinematics. (auth)

19276 ON VARIATIONAL PRINCIPLES FOR ELECTROMAGNETIC THEORY. Tao, L. N. (Illinois Inst. of Tech., Chicago). J. Math. Phys., 7: 526-30(Mar. 1966).

New variational principles for electromagnetic theory are established. A functional consisting of the field vectors is defined through the use of a convolution, and it is shown that the variation of this functional subject to appropriate constraints is completely equivalent to Maxwell's equations, Ohm's law, and the constitutive equations, together with appropriate boundary and initial conditions. The present formulation does not have the defects of the classical variational principle for electromagnetic theory since it does not require the introduction of scalar and vector potentials and a priori knowledge of the field vectors at the final stage. Two variational formulations for the electric and magnetic field vectors alone are also presented. (auth)

19277 A METHOD FOR MEASURING CURRENT DENSITY IN CHARGED PARTICLE BEAMS. Starling, P. P. (Rutherford High Energy Lab., Didcot, Eng.). J. Sci. Instrum., 42: 899(Dec. 1965).

The current density in a beam of protons or electrons may be obtained from a measurement of the temperature of a tungsten gauze placed in the beam. (auth)

19278 IMAGE ABERRATIONS OF SECOND ORDER FOR MAGNETIC AND ELECTROSTATIC SECTOR FIELDS INCLUDING ALL FRINGING FIELD EFFECTS. Wollnik, H. (Justus Liebig-Univ., Giessen, Ger.). Nucl. Instrum. Methods, 38: 56-8(1965).

As a result of calculations of charged particle trajectories in the main field and in the fringing field of magnetic and electrostatic sector shaped analyzers image aberrations of second order are discussed. Hereby special emphasis is placed upon the influence of the fringing fields. (auth)

19279 A (2 + 1)-DIMENSIONAL MODEL FOR THE QUANTUM THEORY OF GRAVITY. Leutwyler, H. (Univ., Bern). Nuovo Cimento (10), 42A: 159-78(1966).

A (2 + 1)-dimensional Riemannian space satisfying Einstein's equations is investigated as a model for the quantum theory of gravity. This model does not bear any dynamics as there is only one state in which the system can be found: flat space. However, the kinematical aspects of the model are not trivial. It is shown that Feynman's sum over histories leads to a one-dimensional Hilbert space of state vectors and an explicit representation of the physical state vector is given. Various general properties of the gravitational transition amplitude, in particular the canonical constraints, which were previously derived for the full four-dimensional theory, are verified with the explicit solution of this model. (auth)

19280 APPROXIMATE EIGENFUNCTIONS OF THE LIOUVILLE OPERATOR IN CLASSICAL MANY-BODY SYSTEMS. Zwanzig, Robert (National Bureau of Standards, Washington, D. C.). Phys. Rev., 144: 170-7(Apr. 8, 1966).

A variational criterion is used to find approximate eigenfunctions and eigenvalues of the Liouville operator in classical many-body systems. The trial functions are taken to be sums over molecules of functions depending on the position and momentum of a single molecule. In a harmonic lattice, this approach leads to exact eigenfunctions and eigenvalues. In a fluid, the eigenvalue spectrum is continuous, and the eigenfunctions are related to those found by Van Kampen in his study of the linearized Vlasov equation for a plasma. The time dependence of the fluid current density is found by means of these eigenfunctions and eigenvalues. The results show persistent free-particle propagation and damped sound-wave propagation, with relative importance depending on the magnitude of the sound velocity. (auth)

19281 INDIUM ION SOURCE. Daley, Howard L.; Perel, Julius; Vernon, Richard H. (Electro-Optical Systems, Inc., Pasadena, Calif.). Rev. Sci. Instrum., 37: 473-5(Apr. 1966).

An ion source that utilizes a continuously oxygenated porous tungsten surface to generate indium ions is described. Indium vapor supplied to the back of the tungsten ionizer from a reservoir percolates through to the front surface where the indium is evaporated as ions. An accel-decel electrode extraction system is used to increase the ion current capability of the source. The ionizer and reservoir are designed to operate at temperatures in excess of 1000°C and at voltages up to 20 kev. The peak ion current attained was 0.57 mA at an ion energy of 10 kev. (auth)

19282 SOLUTION OF THE NONRELATIVISTIC EQUATIONS OF MOTION FOR A CHARGED PARTICLE IN A CERTAIN CLASS OF VARYING ELECTROMAGNETIC FIELDS. Glikman, L. G.; Kel'man, V. I.; Yakushev, E. M. Zh. Tekh. Fiz., 35: 1997-2003(1965). (In Russian).

The solution of the nonrelativistic equations of motion

for a certain class of motions of a charged particle in a certain class of varying electromagnetic fields is reduced to quadratures and eliminations. The electromagnetic fields considered are those that are axially symmetric, have a median plane which is a plane of symmetry for the electric field and a plane of antisymmetry for the magnetic field, and for which the radial and axial components of the vector potential vanish in the median plane (in the gauge in which the scalar potential vanishes) and the azimuthal component of the vector potential in the median plane has the form $F[r^2/(at^2 + bt + d)]/r$, where r is the distance from the axis, t is the time, a, b, and d are constants, and F represents an arbitrary function. The motions considered are those in which the particle remains in the median plane. The particular form of the vector potential was investigated because it leads simply to an integral of motion. The treatment is different depending on whether the polynomial $at^2 + bt + d$ does or does not vanish during the motion, and special discussion is required for the case in which the particle passes through the point r = 0. (ATD)

19283 ON THE POSSIBLE USE OF A LASER BEAM IN PRODUCING A POWERFUL SOURCE OF ELECTRONS. Bogdankevich, O. V.; Sudzilovskii, V. Yu.; Lozhnikov, A. A. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 35: 2052-3(1965). (In Russian).

A method is described for producing powerful pulses by drawing electrons out of a plasma bunch created during the heating of a cathode by a laser beam. The experimental setup capable of producing these bunches is shown. The dependence of the amplitude of a generated current pulse on the potential difference between the anode and cathode, and on the laser output power at a charging voltage of 6 kv results in the generation of 500-amp, 80-nanosec current pulses, corresponding to a current density of 1800 amp/cm^2 at the anode. Although the physical aspects of the processes occurring in this case are not fully understood and thus call for additional experiments, the amplitude and shape of the current pulses obtained are far more stable than those obtained in a spark discharge. No visible cathode damage was noticed after ~1000 bombardments, which seems to indicate that with improvements such an injector would be capable of delivering even higher current pulses at increased repetition rates. (ATD)

Accelerators

Refer also to abstracts 18515, 18692, 18877, 18889, 19439, 20098, and 20100.

19284 (AECD-EP-8) ENERGY CALIBRATION OF THE DACCA VAN-DE-GRAAFF ACCELERATOR. Hussain, M.; Khatun, S. (Atomic Energy Centre, Dacca (Pakistan)). Oct. 1965. 22p. Dep. mn.

A number of experiments on neutron thresholds and proton-gamma resonances were performed with a view to furnish a calibration curve for the Dacca Van de Graaff accelerator. (M.O.W.)

19285 (BNL-929, pp 44-57) HIGH ENERGY ACCELERATORS. (Brookhaven National Lab., Upton, N. Y.).

Activities associated with operation, maintenance, and improvement of the Brookhaven Cosmotron and Alternating Gradient Synchrotron are summarized. (J.R.D.)

19286 (BNL-10049) ON THE RATE AND TYPE OF BLOW-UP OF DENSE PARTICLE BEAMS. Blewett, J. P. (Brookhaven National Lab., Upton, N. Y.). Feb. 10, 1966. Contract AT-30-2-GEN-16. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A preliminary investigation of the effects of space-charge fields in dense beams of charged particles is described. It is shown that a particle beam having a uniform distribution of charge will continue to have a uniform charge distribution. The belief that dense beams tend to become hollow is shown to be incorrect in several representative cases. (M.O.W.)

19287 (BNL-10095) SOME EMITTANCE MEASUREMENTS ON THE AGS PREINJECTOR WITH THE DUOPLASMATRON ION SOURCE. Wroe, Harold (Brookhaven National Lab., Upton, N. Y.). Feb. 25, 1966. Contract AT(30-2)-Gen-16. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Preliminary emittance measurements are presented that were obtained over a period of about 6 months as various experiments were performed with the duoplasmatron source. A discussion of the results is included. (M.O.W.)

19288 (BNL-10096) SOME MEASUREMENTS OF THE EMITTANCE OF THE OUTPUT BEAM OF THE AGS DUOPLASMATRON ION SOURCE. Wroe, H. (Brookhaven National Lab., Upton, N. Y.). Feb. 15, 1966. Contract AT(30-2)-Gen-16. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A brief description of the ion source is given. The experimental arrangement for the emittance measurements is described. The effects of space charge on emittance measurements are described. The results are presented. (M.O.W.)

19289 (CALT-68-20) ANGULAR PROFILE OF THE SOUTH BEAM FROM PHOTOGRAPHIC PLATE MEASUREMENTS. Groom, Donald E. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Nov. 30, 1964. Contract AT(11-1)-68. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The intensity distribution on a plate that was exposed in the south beam at a point immediately behind a thin radiator was investigated. The experimental results were compared with theoretical predictions. (D.C.W.)

19290 (CALT-68-64) A MANUAL FOR THE NEW CW EXCITER FOR THE LINAC. Internal Report No. 19. Madey, John (California Inst. of Tech., Pasadena. Synchrotron Lab.). Nov. 30, 1965. Contract AT(11-1)-68. 25p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A detailed description of the exciter is presented. The specifications, controls, normal operating parameters, and maintenance procedures are discussed. (M.O.W.)

19291 (CALT-68-67) A RE-CALIBRATION OF THE BEAM ENERGY METER. Thiessen, Henry A. (California Inst. of Tech., Pasadena. Synchrotron Lab.). Feb. 14, 1965. Contract AT(11-1)-68. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The method of operation and a calibration technique for the beam energy meter are discussed. Results of the recalibration are discussed. (M.O.W.)

19292 (CERN-66-5) UN SYSTEME GENERAL DE MESURE NUMERIQUE ADAPTE AU C.P.S. (A General System of Numerical Measurement Suitable for the C.P.S. (CERN Proton Synchrotron)). Barbalat, O.; Ollenhauer, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 1966. 51p. Dep. mn.

An original digital measurement system is described. Its elements are separate modular units. The principle consists in transforming and transmitting the signals to be measured into a time interval or a frequency which is digitized by an electronic counter. The design takes into account the special conditions of a large particle accelerator, especially data transmission. (auth)

19293 (CERN-66-7) MAGNETS WITH IRON YOKES AND FIELDS ABOVE 20 KG. Leeb, K.; Umstaetter, H. H. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 17, 1966. 32p. Dep. mn.

A method is proposed of using iron in magnets with uniform fields and fields with a constant gradient. The method removes the limitation imposed on the magnetic field in conventional magnets by the saturation of iron at 21.5 kgauss. Some 30-kgauss magnets are treated as numerical examples. (D.C.W.)

19294 (CERN-66-9) BEAM STACKING AT HIGH VALUES OF $\Gamma = \sin \varphi_s$. Keil, E.; Nakach, A. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 22, 1966. 29p. Dep. mn.

The process of accumulating a beam in a storage ring by means of r-f stacking at values of $\Gamma = \sin \varphi$ between 0.5 and 0.84 is discussed. The results of statistical studies on a computer at these values of Γ are presented. The results indicate that such stacking processes can be done with efficiencies well above 50% for stacks consisting of 100 or more pulses. (auth)

19295 (CERN-66-11) STABILIZATION OF A VAN DE GRAAFF GENERATOR. Carter, C.; Hansen, S.; Jones, E.; Nettleton, R. A. W. (European Organization for Nuclear Research, Geneva (Switzerland)). Mar. 7, 1966. 26p. Dep. mn.

A stabilization system that was developed to keep the pulse-to-pulse energy fluctuation of the beam injected into CESAR from the double-beam electron Van de Graaff stable to better than 1 part in 104 is described. (D.C.W.)

19296 (EUR-2641.d,f,e) ACCELERATOR TARGETS DESIGNED FOR THE PRODUCTION OF NEUTRONS. Proceedings of the Meeting held at Grenoble, France, June 21-22, 1965. (Liege Univ. (Belgium)). 1966. 372p. In Dutch, French, and English. (CONF-650635). Dep. mn.

The proceedings of a conference on accelerator targets for the production of neturons are presented. The improvement of tritium targets was emphasized. (D.C.W.)

19297 (IAE-973) IZOTOPNYE MISHENI DLYA YADERNYKH ISSLEDOVANII. (Isotope Targets for Nuclear Investigations). Bochin, V. P. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 20p. Dep. mn.

The technology of preparing free metal foils of micron thicknesses from isotopes of Fe, Cr, Ni, Zn, Os, Ru, and Pt is examined. A method of regenerating the isotopic material is described, and possible losses of isotopes are pointed out. (tr-auth)

19298 (JINR-P-2281) USTROISTVO SISTEMY RASTYAZHKI PUCHKA PROTONOV SINKHROTSIKLOTRONA NA 680 Mev. (Design of a System for Expanding Proton Beam in a 680 Mev Synchrocyclotron). Danilov, V. I.; Enchevich, I. B.; Rozanov, E. I.; Smirnov, V. I.; Tomilina, T. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 16p. Dep. mn.

An increase in the pulse duration of a beam can be carried out by locally perturbing the magnetic field of an accelerator at the outer radii of the flight path. The perturbation is produced by feeding a pulse current to two coils mounted within the accelerator chamber. The pulse current is fed in synchronization with the accelerating cycle after cutting off the accelerating field. The construction and mounting of two such perturbing coils connected in series are described. Operation of the thyratron control circuit is described in detail. The coils are made of copper tubing covered with glass cloth and an epoxy compound. (TTT)

19299 (MURA-707) PREACCELERATOR COLUMN DESIGN. Curtis, C. D.; Lee, G. M. (Midwestern Universities Research Assn., Stoughton, Wis.). Feb. 15, 1965. Contract W-31-109-38-1707. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The design of an accelerating column for proton beams of 200-400 mamp requires special attention to space charge forces if distortions of beam emittance due to aberrations are to be avoided. A high gradient column designed to accelerate a large diameter beam in a converging spherical field is presented. The re-entrant structure of titanium and stainless steel electrodes has good ion source accessibility and is designed to operate at 750 kv with a 30-cm accelerating gap. The ceramic column of 21-inch length resides in a pressurized atmosphere, which is contained by a filament-wound fiberglass vessel $3\frac{1}{2}$ feet in diameter and seven feet in length. (auth)

19300 (N-65-23065) FINITE AND INFINITE H-PLANE BIFURCATION OF WAVEGUIDE WITH ANISOTROPIC PLASMA MEDIUM. Lee, S. W.; Lo, Y. T.; Mittra, R. (Illinois Univ., Urbana. Dept. of Electrical Engineering). Mar. 1965. 31p. (NASA-CR-62470; SR-4). CFSTI $2.00 cy, $0.50 mn.

The problem of H-plane bifurcation in a parallel-plate waveguide filled with homogeneous, anisotropic plasma is considered. The static magnetic field is assumed to be along the edge of the septum. By using the Wiener-Hopf technique, the complete field solutions are obtained for both semi-infinite and finite bifurcations. (STAR)

19301 (NIRL-R-44) NIMROD—A 7 Gev PROTON SYNCHROTRON. PART I. Loach, B. G.; Southworth, B. (eds.) (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 550p. Dep. mn. BIS $6.00, HMSO 30s. 0d.

The design, construction, commissioning, and operation of Nimrod are discussed in detail. Separate sections discuss in detail the computation and theoretical work, injection system, magnet and associated systems, magnet power supply, r-f system, extraction systems and internal targets, vacuum system, control system, ancillary plant, and operations. (M.O.W.)

19302 (NP-15796) OGRANICHENIYA TOKA V USKORITELE, SVYAZANNYE S PREDEL'NOI PLOTNOST'YU CHASTITS V FAZOVOM OB'EME. (Current Limitation in Accelerator due to Particle-Density Restriction in Phase Volume). Sivkov, Yu. P.; Solnyshkov, A. I. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 18p. Dep. mn.

The particle density in phase space does not depend on the type of focusing field, and is determined by processes at the ion source outlet. The acceptance, that is, the volume in phase space, is determined by the parameters of the magnetic field and by the allowable amplitude of the betatron oscillations. Therefore, the magnitude of the current which can be introduced into an accelerator at a given injection energy is limited for any source of a given type. The problem of focusing a beam introduced into an accelerator consists in having the points of phase space representing the coordinates and momenta of the particles fall within the acceptance. The beam current is plotted as a function of the four-dimensional reduced phase volume. The results indicate that the particle density in four-dimensional phase volume can be considered a constant. Limiting currents are calculated for various accelerators at CERN, Argonne, Brookhaven, and Dubna (USSR). The limiting particle density in phase volume is a real restriction for most modern accelerators. (TTT)

19303 (PPAD-581D) MAGNET FLAT TOPPING SYMPOSIUM SUMMARY. Riedel, J. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Feb. 9, 1966. Contract AT(30-1)-2137. 19p. (CONF-660104-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Magnet Flat Topping for Rapid Cycling Particle Accelerators, Princeton, N. J.

The existing magnet power supplies in use at the PPA, DESY, and CEA were briefly described, and then various proposed flat topping schemes to be used on these machines were discussed. A flat topping scheme for the proposed Saclay 12-Bev electron machine was presented. Subsequently, the Brobeck proposal for flat topping the Cornell machine was described. (M.O.W.)

19304 (SLAC-55) MAGNETIC CHARACTERISTICS OF THE ACCELERATOR QUADRUPOLE TRIPLETS. Cobb, J. K.; Burfine, A. W. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Jan. 1966. Contract AT(04-3)-515. 31p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The results of the measurement of certain electric and magnetic characteristics of 62 of the QA magnets and 31 of the QB magnets are presented in statistical form. (M.O.W.)

19305 (TID-22772) A REVISION OF SHIELDING CALCULATIONS. Wilson, Richard (Cambridge Electron Accelerator, Mass.). May 12, 1959. Revised May 1963. Contract AT(30-1)-2076. 34p. (CEA-73). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Old shielding calculations are included and changes to be made are pointed out. The changes arise from the following: (1) a better evaluation of the attenuation in the nuclear cascade, giving a higher background; (2) an estimate of the low energy neutrons in equilibrium with the high energy neutrons, previously not evaluated; (3) the improved knowledge of photopion cross sections at 1 Bev showing that the cross sections do not fall off at high energies; and (4) a realization that there is a "hole" in shielding of low energy neutrons by iron below 1 Mev. (M.O.W.)

19306 (ZfK-PhA-2) STABILITAET DER IONENBAHNEN BEI EXZENTRISCHER BESCHLEUNIGUNG. (Stability of Ion Orbits in Eccentric Acceleration). Keck, C. (Zentralinstitut fuer Kernphysik, Rossendorf bei Dresden (East Germany)). Nov. 1960. 20p. Dep. mn.

An analysis of the stability of ion orbits in eccentric magnetic fields is summarized. (D.C.W.)

19307 IMPROVEMENTS AT THE SYNCHROCYCLOTRON. CERN Cour., 2: 30-3(Feb. 1966).

An improvement program for the CERN 600-Mev synchrocyclotron is described. In order to meet the research requirements the performance of the synchrocyclotron is to be developed until some natural limit is reached. That is, the full potential of the existing machine will be reached without major transformations except for rebuilding the r-f system. Topics considered are the internal beam, beam extraction, the various beams of the synchrocyclotron, and the underground tunnel. (J.F.P.)

19308 IMPROVEMENTS MADE TO A 1.5-Mev ELECTRON ACCELERATOR DESIGNED FOR THE FEED OF A LARGE ELECTRON MICROSCOPE. Dupouy, Gaston; Perrier, Frantz; Seguela, Andre (CNRS, Toulouse). Compt. Rend., Ser. B, 262: 341-6(Jan. 31, 1966). (In French).

Modifications that made it possible to obtain, using a 1.5-Mev accelerator, a well-centered electron beam, an operation free from vibrations, and extreme stability of the high voltage are described. (tr-auth)

19309 A SPUTTERING ION SOURCE. Hill, K. J.; Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods, 38: 15-18(1965).

A universal ion source is described in which ions of any metal or gas may be produced. The disadvantages of earlier sources which used the salt of the metal as the source material are overcome by using sputtering from a metal electrode to release atoms into a plasma where they become ionized. Alternatively the source may be operated with a gas alone feeding the plasma, in order to make gas ions. Aluminium, copper, iron, gold, silver, argon and xenon mamp beams have so far been extracted. The source is at present installed on the Heavy Ion Accelerator at Harwell where it is used with an accelerating voltage up to a maximum of 160 kv for studies of radiation damage processes. (auth)

19310 THE OCCURRENCE AND MEASUREMENT OF ACCIDENTAL COINCIDENCES IN EXPERIMENTS USING PULSED ACCELERATORS. Griffiths, R. J. (London Univ.); McClatchie, E. A.; Johnston, A. R.; Gibson, W. R. Nucl. Instrum. Methods, 40: 181-91(Mar. 1966).

The calculation and measurement of accidental coincidence rates in detector systems using pulsed accelerators are considered in detail. Accidental counting rates are expressed as a function of the coincidence resolution of the detector system, the pulse structure of the beam intensity and of the delay in the coincidence unit inputs. (auth)

19311 RESTATEMENT OF A METHOD OF NUMERICAL STUDY OF LINEAR ACCELERATORS. APPLICATION TO A STUDY OF ALTERNATE-PHASE FOCUSING. Teissier, G.; Chabert, A.; Veyron, B. (Institut de Physique Nucleaire, Lyon). Nucl. Instrum. Methods, 40: 197-203 (Mar. 1966). (In French).

The rectification and the application to some idealized cases of linear accelerators of the method of numerical study are presented, the principle of which was exposed previously. In particular very short times of calculation and a precision limited by the number of terms introduced (in fact by the time on the computer) are obtained. The scalars describing the field effects are given either analytically (if the field itself is given analytically from theoretical studies) or calculated from experimental data (measurements on structures), or given by means of programs similar to, e.g., "Messy Mesh." (auth)

19312 ROLE OF THE MODERN CYCLOTRON IN NUCLEAR RESEARCH. Conzett, H. E.; Harvey, B. G. (Univ. of California, Berkeley). Nucleonics, 24: 48-57 (Feb. 1966).

A review and summary of a sector-focused cyclotron is presented. The essential difference between the conventional and the sector-forced cyclotron are described, and the advantages of the newer cyclotron for nuclear research are discussed. These capabilities are considered for isotope production in which the high phase-space beam density, energy resolution, the high maximum energy, and energy variability of this cyclotron are discussed. (J.F.P.)

19313 ACCELERATORS FOR LOW AND MEDIUM ENERGIES. Eckardt, A. Phys. Bl., 21: 549-57(Dec. 1965). (In German).

A brief review is given of improvements in design, construction, and techniques of acceleration in order to obtain the desirable acceleration characteristics at low and medium energies. (J.S.R.)

19314 THE FIXED FREQUENCY CYCLOTRON (1965). Burcham, W. E. (Univ. of Birmingham, Eng.). Sci. Progr. (London), 53: 621-32(Oct. 1965).

The fixed-frequency cyclotron in its original form is limited in output energy by the relativistic increase of particle mass with velocity. Variation of the magnetic field with azimuth provides additional focussing forces so that this limitation can be removed. The construction of an efficient fixed-frequency orbital accelerator for the 60–100 Mev energy range then becomes possible. The application of such a cyclotron to nuclear structure research is discussed, with particular reference to the features of maximum energy, duty cycle, acceleration of different particles, extraction efficiency, and variation of external beam energy. It is concluded that an azimuthally varying field cyclotron competitive in many respects with a tandem electrostatic accelerator could not be constructed at comparable cost. (auth)

19315 DESIGN OF ACCELERATOR TUBES WITH INCLINED ELECTRODES. Kuznetsov, V. S.; Fidel'skaya, R. P. Zh. Tekh. Fiz., 35: 2004-11(1965). (In Russian).

Van de Graaff et al. (Nature, 195: 1292(1962)) have shown that voltage breakdown in Van de Graaff-type particle accelerators due to regenerative multipaction of secondary particles can be overcome by constructing the accelerator tube in sections in each of which the plane accelerating electrodes are inclined to the plane normal to the axis, the inclinations being opposite in successive sections. Advantages are pointed out of so constructing inclined electrode accelerator tubes that the accelerated ion spends the same time in each section. In such an inclined electrode accelerator tube with equal flight-time sections, the effects on the ion motion of the opposite transverse fields in successive sections exactly compensate each other, and less compensating inclination is required of the injected beam than in the case of an accelerator tube with sections of equal length. Moreover, the presence of a long section with uniform transverse field at the output end of the tube minimizes contamination of the beam with low energy particles. The necessary equations are derived for the design of inclined electrode accelerator tubes with equal flight-time sections. In the derivation the effects of the prismatic fields in the coupling regions between sections are at first neglected; the effects of the prismatic fields are subsequently calculated and the requisite corrections to the design equations are given. These corrections are found to be negligible in the first approximation. (ATD)

19316 INFLUENCE OF SPACE CHARGE ON THE LONGITUDINAL MOTION OF PARTICLES IN ACCELERATORS DURING INJECTION. Samoilov, I. M.; Sokolov, A. A. Zh. Tekh. Fiz., 35: 2012-20(1965). (In Russian).

The influence of longitudinal space-charge variations on the motion of charged particles in a weak-focusing cyclic machine is discussed in which stable bunches are formed or into which the particles have been injected during a time slightly shorter than that required for a full revolution, thus forming a single artificial bunch. It is shown that radial-phase oscillations develop as a result of the Coulomb interaction of the bunched particles. and equations describing these oscillations are derived. These oscillations limit the total charge that can be accumulated in the orbit, owing to the limited radial width of the channel. Injection experiments, using an internal injector, were performed with the BSB installation. The accumulated charge increased linearly with injection energy for injection energies from 20 to 80 kev. As a function of injection current, the captured charge reached a maximum at an injection current slightly above 0.1 amp, whereas transverse space charge effects should not be significant for injection currents below about 1 amp. It is concluded that the accumulated charge was limited by the longitudinal space charge effects discussed above. Quantitative agreement with the theory was not achieved; the measured accumulated charge was less than the calculated value by approximately a factor 2.5. Possible reasons for this discrepancy are coherent radiation and inaccurate evaluation of some of the parameters. After some discussion it is concluded that the discrepancy is not greater than can be reasonably accounted for. The maximum possible charge that can be accumulated, calculated with the present theory, increases rapidly with increasing injection energy, and it is concluded that the gamma yield of betatrons can be increased by more than three orders of magnitude by increasing the injection energy to 1.0–1.5 Mev. The effect of energy scattering in the injected beam is discussed in an appendix. (ATD)

19317 USE OF THE 3/2-RADIAL RESONANCE IN EXTRACTION FROM A SIX-SECTOR ISOCHRONOUS CYCLOTRON [Thesis]. Hopp, David Ian. Los Angeles, Calif., Univ. of California, 1965. 88p.

An investigation was made of the use of the $\nu_r = 3/2$ resonance in the extraction of particles from six-sector isochronous cyclotrons. Four pole-face geometries, two high spiral angle and two medium spiral angle, were used. The median-plane field was represented by a single harmonic. It was found that the dependence of the betatron frequency on the oscillation amplitude was very small; also, in the absence of error fields the $3/2^-$ resonance may easily be traversed. Upon introduction of a third harmonic gradient bump the motion becomes unstable and extraction is possible. The phase of the bump is very important and large quantitative differences in the extraction occur as the phase is changed. The well-behaved nature of the phase-space, and the difference between half-integral and integral resonance extraction allows two 50% beams to be extracted, simultaneously, at two different azimuths, or with proper preparation of the center region, one 100% beam only. The extraction energy is approximately 400 Mev. (Dissertation Abstr.)

19318 ELECTRON CURRENT MEASURING DEVICE FOR A CHARGED-PARTICLE BEAM. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-1554. Jan. 27, 1965. Filed Aug. 29, 1962.

An improved electron current measuring device is proposed for a charged particle beam accelerated by a particle accelerator. In the device proposed, in a metal tube through which an accelerated beam passes, an electric conduction tube is installed by means of an insulated support. The electric charge produced in the electrode by electrostatic induction is drawn out and measured. (NSA of Japan)

19319 CHARGED PARTICLE SOURCE. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-1638. Jan. 28, 1965. Filed Nov. 28, 1962.

A charged-particle source is proposed that produces a wave-shaped pulse between the two electrodes of an electron gun and that yields simple and accurate control of an electron beam. The proposed device is also applicable for ion sources producing ions of hydrogen, argon, etc.; and the high-energy charged particles thus obtained are suitable for use in radiation chemistry, material working by a charged-particle beam, etc. When charged-particle rays of still higher energy are required, the pulsed charged-particle beam of good wave-shape obtained by the device can further be accelerated in a linear accelerator, etc. The first pulse high-voltage in the device is used as the charged-particle accelerating voltage, which is induced at both ends of the secondary windings in a high-voltage pulse transformer having a number of secondary windings. A delay line with uniformly distributed constants is formed by at least two of the secondary windings. The secondary pulse voltage provided from one end and the pulse voltage supplied to the other end is used as the voltage to control the drawing-out of charged particles. (NSA of Japan)

19320 CHARGED PARTICLE ACCELERATOR. Seto, Shoji (to Nippon Atomic Industry Group Co., Ltd.). Japanese Patent 1964-1639. Jan. 28, 1965. Filed Apr. 18, 1964.

The proposed charged-particle accelerator includes a device for switching ion acceleration to electron acceleration, or vice versa. The charged-particle accelerator consists of the following: a charged-particle accelerating tube; a plasma-producing device installed on the side of particle injection of an accelerating tube; a pair of electrodes arranged on both sides of the axis of the plasma-producing device; a source of electricity, which supplies the voltage of reverse polarity to this part of electrodes; and a device, which converts the polarity of the voltage. (NSA of Japan)

19321 DEVICE FOR INDICATING A FIELD OF PARTICLE IRRADIATION. Iwashita, Fumio (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-1640. Jan. 28, 1965. Filed Sept. 30, 1964.

A device for attachment to particle accelerators, etc. for indicating the central point and distribution fluxes in an irradiation field consists of a number of particle detectors, such as ionization chambers or semiconductors, assembled in a thin frame. The radiation dose is not reduced by the installation of the detector array, because the detectors detect only the scattered radiation. (TCO)

19322 PULSED-BEAM SOURCE FOR A PARTICLE ACCELERATOR. Komai, Kenichiro (Hitachi, Ltd.). Japanese Patent 1964-3078. Feb. 17, 1965. Filed Dec. 27, 1963.

A pulsed-beam source is proposed in which the characteristic adverse effect that usually is produced when the bias or pulse voltage fluctuates is eliminated. The source, includes injection of charged particles from their source; focusing of the injected particles; periodic deflection of the focused beam in a device having two opposing electrodes; and, finally, injection through an aperture of the pulsed beam into an accelerating tube. One of the (said) deflecting electrodes is grounded, and the other electrode is impressed by the anode voltage of the last amplifier of a pulsation device cutting off the charged-particle beam. Thus, the beam is deflected and pulsed by the conduction of the last amplifier. Using the method proposed, the pulsed beam into an accelerating tube can be kept constant irrespective of the fluctuation of the bias or pulsed voltage. (NSA of Japan)

19323 DEVICE FOR STABILIZING THE ACCELERATING VOLTAGE FOR CHARGED PARTICLES. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-3079. Feb. 17, 1965. Filed Apr. 18, 1963.

A voltage stabilizing device consists of a deflector for charged-particle rays; detectors to detect the deflected particle rays as an electric current; a device, which gives the ratio of electric currents, related to the accelerating voltage; and a device, which controls the specified output voltage of the high-voltage power source, by comparing the

voltage ratio with a standard value. The ratio of the electric current for the particle-ray beam to that given by a detector is used as the (said) electric current ratio. The device is applicable to an ultrahigh-voltage electron microscope, ion beam accelerators, etc. (NSA of Japan)

Astrophysics and Cosmology

Refer also to abstracts 19412, 19645, 19679, 19708, and 19714.

19324 (N-65-21300) STUDY OF THE APPLICATION OF PERCEPTRONS FOR PREDICTION OF SOLAR FLARES. SOLAR FLARE FORECASTING WITH A RECOGNIZING AUTOMATION. Final Report, Phase II. Theiss, C. M.; Murray, A. E. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Feb. 1965. Contract NAS5-3825. 65p. (NASA-CR-57992; CAL-VS-1945-X-1). CFSTI $3.00 cy, $0.75 mn.

A multiple-factor classification technique, of a sort resembling learning machines, was experimentally applied to forecasting solar flares likely to have produeed proton showers in the interplanetary space. Type-IV radio emission was used as a criterion for this likelihood, since the two phenomena are highly correlated, and the radio emission is likely to be detected although the high-energy protons may not reach the earth. In Phase I, a forecast accuracy of 77% was achieved in predicting the occurrence of spectral type-IV flares within a given region of the sun. In Phase II, effort was concentrated on refining both the data and the experimental method. (STAR)

19325 (N-65-22651) ORIGIN OF SOLAR FLARES AND THE ACCELERATION OF CHARGED PARTICLES. Wentzel, Donat G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1963]. 33p. (NASA-TM-X-55211; X-640-63-204). CFSTI $2.00 cy, $0.50 mn.

Various theories concerning solar flares are briefly reviewed. Major considerations are the creation of magnetic energy through the energy radiated by a large flare and the rapidity with which the magnetic energy is converted to radiation. Also discussed are the observed phenomena associated with optical flares which involve more energy than the optical emission has. These arguments show that the location of particle acceleration is the injection energy. It is concluded that the theories discussed explain only one type of particle and cannot be convincing unless several phenomena associated with a flare are included. No theory naturally explains the duration of the solar flare and the shape of the light curve. (STAR)

19326 (N-65-23194) STABILITY AND STRUCTURE OF SHOCK WAVES IN INTERPLANETARY SPACE. Hinton, F. L. (RAND Corp., Santa Monica, Calif.). Apr. 1965. Contract NASr-21. 43p. (NASA-CR-62521; RM-4490-NASA).

Postulating the structure of shock waves in a low-density plasma, several features of interplanetary shock waves observed by satellites and space probes are explained. Unsteady flow behind the shock wave is shown to be caused by the refraction of small-amplitude disturbances through the shock. The shock wave is stable, however, with respect to small perturbations in the fluid variables, because the problem of the refraction of small-amplitude disturbances through a fast hydromagnetic shock wave has a unique solution. The length for the unsteady flow's onset, characteristically a few ion cyclotron radii, agrees with the experimental data. A possible explanation is offered for the increase in the flux of low-energy electrons seen by Explorer XII as the satellite passed inward behind the earth's bow shock on September 13, 1961. (STAR)

19327 (N-65-27406) ANTARCTIC RESEARCH AND DATA ANALYSIS. TIME STRUCTURE OF GROUND LEVEL AND SATELLITE COSMIC-RAY INCREASES. Bennett, Sidney M. (Research and Advanced Development Div., Avco Corp., Wilmington, Mass.). May 15, 1964. Contract NSF-C-255. 86p. (RAD-TR-64-12).

The morphology of solar-related terrestrial cosmic-ray increases was studied using neutron-monitor, satellite, and riometer data. Data from numerous events were compared with the power law intensity decay $I(P > P_0) = I_0(P > P_0)t^{-m}$ with t taken as zero at the "flash phase" of the solar flare. It is concluded that a power law decay with m = 2.0 is representative of the decay phase of moderate- to high-energy solar cosmic-ray events. Two diffusion theories and a uniform magnetic field theory for propagation of solar particles in interplanetary space are discussed. The power law decay with exponent m = 2.0 corresponds to the theory which requires an essentially uniform magnetic field strength along the path. It is suggested that the magnetic fields which guide solar cosmic rays arise in the solar "centers of activity" and not in the individual sunspots. Re-analysis of the delay time versus the heliographic longitude of the flare supports the results of Obayashi and Hakura, who found that a definite East-West asymmetry exists. It is found that the delay time decreases markedly (and rather suddenly) when the flare region crosses the central meridian. (STAR)

19328 (NP-15939) LABORATORY SIMULATION OF MAGNETIC FIELDS PRODUCED IN THE MOON BY THE TRAPPED FIELD OF THE SOLAR PLASMA STREAM. Brown, I. G.; Gold, T.; Watson-Munro, C. N. (Sydney Univ. (Australia). School of Physics). Jan. 1966. 6p. (ER-18). Dep. mn.

The magnetic field of a laboratory "moon" in a plasma stream was investigated. A stainless steel "moon" of 2 cm. radius was located in a rotating ionizing plasma shock wave. The results are discussed. (M.O.W.)

19329 STUDY OF THE POLARIZATION OF FORBIDDEN LINES OF THE SOLAR CORONA, APPLICATION IN THE CASE OF THE GREEN LINE λ 5303. Charvin, Pierre (Observatoire Paris-Moudon, France). Ann. Astrophys., 28: 877-934(Nov.-Dec. 1965). (In French).

The expression of the angular correlation of resonance photons is discussed. This expression is then generalized to apply to all coronal forbidden lines irradiated by atoms with zero nuclear spin, taking into account all processes acting upon the excited state. This analysis is simplified by the value of the magnetic field in the lower corona, which is likely to be higher than $10^{-5}-10^{-4}$ Oe. Then, the photoexcitation probabilities are computed for any orientation of the magnetic field. The populations of Zeeman sublevels of the excited state are derived and the Stokes' parameters of the light irradiated by a volume element of the corona are obtained. This radiation is partially plane polarized; the plane of polarization contains the magnetic field or is perpendicular to this field. A quantitative analysis is limited to 5303 Å and 10747 Å coronal lines. Computations are carried out for the green line 5303 Å and new problems are examined which arise from the integration along the line of sight. Numerical results are given for the intensity Γ and the polarization p_m for several coronal models and different magnetic field patterns. In favorable cases, polarization measurements can give the magnetic field orientation as projected on a plane perpendicular to the line of sight and two parameters such as, for instance, the electron density N_e and a parameter function of T_e. The existing data are examined. Although it is still insufficient to draw detailed conclusions, it seems that: the present theory is valid; the magnetic field is preferentially radial at the base of the low-latitude streamers; and the probability of collisional excitation $b_{0.1}$ is close to its computed value. (BBB)

19330 BERYLLIUM IN F- AND G-TYPE DWARFS. Merchant, Ann E. (Lick Observatory, Mount Hamilton, Calif.). Astrophys. J., 143: 336-42(Feb. 1966).

The abundance of beryllium (relative to the sun) was determined in 10F- and G-type stars from the λλ 3130, 3131 resonance lines of Be II, for comparison with the lithium abundances in these same stars. The position of the continuum was carefully checked in an attempt to make the data not only internally consistent but also meaningful when compared with other stars and other elements. With the exception of two stars, θ Cyg and α CMi, the total

spread in Be abundance is a factor of four as compared to a Li spread in these same stars of a factor of 30. The stars θ Cyg and α CMi have upper limits on Be of 25 times less than solar; the possible effect of the companions of these two stars on the light-element abundances is considered as a possible explanation of this phenomenon. Four of the stars have appreciable amounts of ^{6}Li; this is interpreted to mean that there has probably been little or no convective depletion of either Li or Be. The mean abundance ratio of Li/Be for these four stars is 0.6, with a variation about the mean of 50 per cent. This may represent a constant initial value of Li/Be; a fixed ratio would be expected if production of these light elements were the result of spallation. (auth)

19331 A HIGH-PRECISION PHOTOMETRIC SCAN AT λλ 8667-8668 A IN THE SOLAR SPECTRUM: A TENTATIVE IDENTIFICATION AND ABUNDANCE DETERMINATION OF BORON IN THE SUN. Waddell III, J.; Slaughter, Charles D. (Kitt Peak National Observatory, Tucson, Ariz.). Astrophys. J., 143: 343-51(Feb. 1966).

Photoelectric observations were obtained in the solar wavelength region λλ 8667–8668 Å using a solar telescope. An average scan of 200 digitally recorded observations in the spectral region realized a smoothness of 0.005 per cent in intensity between every 0.015-Å interval, and a calculated "probable error" of 0.012 per cent. The observations were obtained and reduced to yield an effective resolving power of 170000. The studied spectral region corresponds to a laboratory identification of a 3p-5s neutral boron transition. The analysis of the observations suggests an identification of boron. The stronger line of the multiplet has a central absorption of 1.5 per cent and Doppler width of 0.114 Å. The resulting calculation of the abundance of boron in the sun yields $\log A_B = -6.40 = 5.60 - 12.00$. (auth)

19332 THE ABUNDANCE OF NICKEL IN THE SOLAR ATMOSPHERE. Cowley, C. R. (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 143: 352-7(Feb. 1966).

A new determination of the abundance of nickel in the solar spectrum was made based on the model atmosphere of Mutschlecner and a recent compilation of gf-values by Corliss. The only reliable gf-values for nickel that were available before the work of Corliss were for lines in the ultraviolet region of the spectrum where solar line-strength data were unsatisfactory. A value of 5.69 for the logarithmic abundance of nickel was found, in good agreement with a recent compilation by Aller. The dependence of the shape of the theoretical curve of growth on excitation potential is also discussed. (auth)

19333 THE "STANDARD MODEL" FOR MASSIVE STARS IN GENERAL RELATIVITY. Tooper, Robert F. (IIT Research Inst., Chicago). Astrophys. J., 143: 465-82(Feb. 1966).

Using general relativity, models of very massive hot stars composed of ideal gas and radiation are described in which the ratio of gas pressure to total pressure is assumed to be constant throughout a particular configuration. Under this assumption, a relation between pressure and energy density is obtained which is similar in form to an adiabatic equation of state with n = 3, but which includes the internal energy density of the gas as well as the radiation. The solutions of the general-relativistic equations of hydrostatic equilibrium (for spherical symmetry) appropriate to this equation of state depend on two parameters: the ratio α of central pressure to central rest-energy density, and the ratio β of gas pressure to total pressure. Expressions are given which relate the variables describing the internal structure of the configurations to the solutions of the differential equations of equilibrium. The mass and radius are expressed in terms of α and β but depend on quantities that have to be found by solving the equilibrium equations. The central values of the temperature, rest-mass density, and pressure are expressed in terms of α and β directly. Integrals for the rest energy, proper kinetic energy, and energy of radiation are obtained, and the integral for the rest energy appears in an expression for the binding energy of the system. Stability against radially symmetric perturbations is determined using Chandrasekhar's variational principle. For $\beta \ll 1$, corresponding to the most massive objects, the equations of equilibrium have the same form as those for an adiabatic sphere with n = 3, and the solutions depend on the parameter α only. The results from numerical integration of the equilibrium equations are presented as contours of constant mass and radius in the $\log_{10} \alpha - \log_{10} \beta$-plane. The region of stability in this plane is obtained by numerical calculation from the variational principle. For $\beta \ll 1$, instability occurs for small values of α, and a post-Newtonian approximation is adequate to describe the stable configurations. (The equivalent Newtonian models are all stable if the ratio of specific heats of the gas is greater than $4/3$.) When β is not small compared to unity, the equations must be integrated to give a two-parameter family of solutions. The binding energy can be calculated correctly only when β is not set equal to zero. For large masses and radii the instability sets in along a curve in the $\log_{10} \beta$-plane where the binding energy as a function of α, with fixed β, has a relative maximum. For a marginally stable object of mass 10^8 M⊙, the radius is ~0.5 light-year. A post-Newtonian approximation giving the internal structure of the configurations for small α and β is also presented. The boundary between stable and unstable solutions, as calculated in this approximation, is given by the equation $\log_{10} \beta_{cr} = 1.1985 + \log_{10} \alpha$. (auth)

19334 STELLAR EVOLUTION. III. THE EVOLUTION OF A 5 M⊙ STAR FROM THE MAIN SEQUENCE THROUGH CORE HELIUM BURNING. Iben, Icko Jr. (California Inst. of Tech., Pasadena. Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 143: 483-504(Feb. 1966).

The evolution of a 5 M⊙ population I model ($X_H = 0.708$, $Z = 0.02$) is described and compared with the evolution of the 3 M⊙ model presented previously. The paths in the Hertzsprung-Russell diagram, the relation between interior processes and changes in external characteristics, and the relative time scales associated with different evolutionary phases are qualitatively quite similar for the two stars. Quantitative differences (in addition to a considerable difference in absolute time scales) are of importance. In 5 M⊙ evolution there are two major phases of core helium burning separated in the H-R diagram by a short phase of rapid transit; the path in the H-R diagram during core helium burning extends to higher surface temperatures in the 5 M⊙ case, crossing the region of classical Cepheids; at the red-giant tip, the convective envelope is shallower in the 5 M⊙ case, leading to a less pronounced increase in the surface ratio of ^{14}N to ^{12}C, although the reduction in the surface abundance of Li is about the same as in the 3 M⊙ case. The effect of the uncertainty in the $^{12}C(\alpha,\gamma)^{16}O$ reaction rate is investigated. It is found that, by reducing the $^{12}C(\alpha,\gamma)^{16}O$ cross-section, the maximum surface temperature reached during the core helium-burning phase is decreased. The total time spent in core helium burning is reduced and the final core concentration of ^{12}C is considerably enhanced relative to the final core concentration of ^{16}O. It is shown that the primary maximum found in the number versus magnitude distribution of the classical Cepheids (in any galaxy with a large component of young population I stars) is to be expected as a result of passages through a postulated instability strip during core helium burning. (auth)

19335 STELLAR EVOLUTION. IV. THE EVOLUTION OF A 9 M⊙ STAR FROM THE MAIN SEQUENCE THROUGH CORE HELIUM BURNING. Iben, Icko Jr. (California Inst. of Tech., Pasadena. Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 143: 505-15(Feb. 1966).

A 9 M⊙ stellar model of population I initial composition ($X_H = 0.708$, $Z = 0.02$) is evolved from the main sequence to the stage of helium exhaustion in the core. Comparison is made with the evolution of the 3 M⊙ and 5 M⊙ models described previously. Relative lifetimes for corresponding evolutionary phases and changes in evolutionary paths in the H-R diagram are found to vary in a

consistent way with increasing stellar mass. The phase of rapid envelope contraction associated with the disappearance of envelope convection has much greater observational consequences in the 9 M⊙ case than in the 5 M⊙ case. Passage through the Cepheid strip occurs only once during core helium burning and then on a Kelvin-Helmholtz time scale. The core helium-burning phase is broken into two quite distinct phases, the second phase occurring at much higher surface temperatures than in the 5 M⊙ case. (auth)

19336 STELLAR EVOLUTION. V. THE EVOLUTION OF A 15 M⊙ STAR FROM THE MAIN SEQUENCE THROUGH CORE HELIUM BURNING. Iben, Icko Jr. (California Inst. of Tech., Pasadena. Massachusetts Inst. of Tech., Cambridge). Astrophys. J., 143: 516-26 (Feb. 1966).

The evolution of a 15 M⊙ star of population I composition is described and compared with the evolution of less massive stars presented previously and with the evolution of a 15.6 M⊙ star calculated by Hayashi and his collaborators. During the core hydrogen-burning phase, the evolution of the 15 M⊙ star is qualitatively almost identical with the evolution of the lighter stars. In the 15 M⊙ star, during the phases of over-all contraction and hydrogen-shell development, matter becomes unstable against convection in a large region extending outward from the developing shell. The redistribution of composition variables in this region has an effect on the surface abundances when the star reaches the red-giant tip. Core helium burning in the 15 M⊙ star occurs at much higher surface temperatures than is the case with less massive stars and requires a significantly longer time interval than that found for the 15.6 M⊙ star. Contrary to the results of Hayashi and Cameron, the surface temperature of the 15 M⊙ star decreases throughout the core helium-burning phase. Passage across the observational Cepheid strip and motion along the red-giant branch do not occur until near the end of the core helium-burning phase of the 15 M⊙ star. (auth)

19337 PROBLEMS OF NUCLEOSYNTHESIS IN THE SUBDWARFS GAMMA PAVONIS AND ZETA^1 RETICULI. Danziger, I. J. (Mount Wilson and Palomar Observatories, Pasadena, Calif.). Contract AF 49(638)-1323. Astrophys. J., 143: 527-34(Feb. 1966).

The spectra of the southern subdwarfs γ Pav and ζ^1 Ret were investigated at high dispersion. A curve-of-growth analysis of γ Pav relative to the sun showed that elements lighter than Ni are underabundant by a factor of 0.7 in the logarithm. In ζ^1 Ret this factor is 0.4. In both stars the underabundance of carbon was considerably greater than of other elements, −1.3 in the logarithm for γ Pav and −0.8 for ζ^1 Ret. Mn proved to be not more underabundant than Fe. The heavy rare-earth elements in both stars are more underabundant than the Fe group. The present theory of slow neutron capture, producing the s-process elements, is supported by the construction of diagrams of log N σ as a function of the atomic weight A. The data for γ Pav as well as for a series of previously analyzed objects show stellar material with different histories of slow neutron exposure. (auth)

19338 INTERPRETATION OF THE SOFT X-RAY SPECTRUM OF THE SUN. Widing, Kenneth G. (Naval Research Lab., Washington, D. C.). Astrophys. J., 143: 606-9(Feb. 1966).

It is shown that with an isothermal model of the quiet corona at 1.8 $(10)^6$ °K the line intensities of the carbon and magnesium ions in the observed soft x-ray spectrum of the sun can be represented. Some of the more important observed lines and estimated fluxes are given. Also the ionization equilibria for C, O, Ne, Si, and S were computed. (J.F.P.)

19339 ON THE ABUNDANCE OF INTERSTELLAR OH. Carroll, T. O.; Salpeter, E. E. (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 143: 609-12(Feb. 1966).

It is shown that the OH abundance in interstellar space is mainly controlled by gas-kinetic-exchange reactions involving H, H_2, and O during the short cooling periods following cloud-cloud collisions. Ultraviolet radiation beyond the Lyman edge is neglected so that H, H_2, and O are predominantly neutral. It is assumed that photodissociation of OH can be neglected if radiation beyond the Lyman edge is absent. Numerical results for ratios of the number of hydroxyl radicals to the number of oxygen atoms for various activation energies are given. (J.F.P.)

19340 IDENTIFICATION OF TWO SOUTHERN QUASI-STELLAR OBJECTS. Ekers, R. D. (Univ. Grounds, Chippendale, Australia. Mt. Stromlo Observatory, Canberra, Australia). Austral. J. Phys. 18: 669-70(Dec. 1965).

A number of possible quasi-stellar objects have been found from a search of the Palomar Sky Survey plates for identification of radio sources in the Parkes catalog (Bolton, Clarke, and Ekers 1965). Confirmation of the identification of two of these sources, 1327-31 and 2115-30, was obtained from both precise optical and radio position measurements and photoelectric observations. The results are tabulated. (L.B.S.)

19341 THE RELATIVE ISOTOPIC ABUNDANCE OF ^{40}K IN TERRESTRIAL AND METEORITIC SAMPLES. Burnett, D. S.; Lippolt, H. J.; Wasserburg, G. J. (California Inst. of Tech., Pasadena). Contracts Nonr-220(47); NGR-05-002-028; AT(04-3)-427. J. Geophys. Res., 71: 1249-69(Feb. 15, 1966).

Fowler, Greenstein, and Hoyle have proposed that the inner solar system was heavily irradiated during its formation. A consequence of this proposal is that sizable differences in meteoritic and terrestrial $^{41}K/^{40}K$ ratios are possible if the fraction of material which was irradiated was different in the two cases. The isotopic composition of potassium was measured by mass spectrometry for nine stone meteorites, silicate from the Vaca Muerta mesosiderite and the Weekeroo Station iron meteorite, and four terrestrial samples. The measured $^{41}K/^{40}K$ ratios were corrected by normalizing the measured $^{39}K/^{41}K$ ratio to the Nier value of 13.47. This normalization procedure approximately cancels out any variations in the isotopic abundance except those due to nuclear processes. Measurements on enriched standards showed that any variations greater than 1% would certainly have been detected, and variations greater than ½% would probably have been detected with replicate analyses. Within these limits, no variations in the ^{40}K abundance between the terrestrial and meteoritic samples could be found which could be ascribed to particle irradiation in the early history of the solar system. Small ^{40}K enrichments were observed in Norton County, Weekeroo Station, and Vaca Muerta; however, these appear to have been produced during cosmic-ray irradiation by the $^{40}Ca(n,p)$ reaction. The present results set relatively strong limitations on possible mechanisms for the formation of the earth and the meteorites if the idea of a large-scale irradiation in the early history of the solar system is to be retained. Independent of the model of Fowler et al., limits were placed on any differential uniform irradiation. The implications of the present work on the K-Ar ages of stone and iron meterorites are discussed. The possibility that iron meteorites are considerably older than the solar system as a whole appears unlikely. (auth)

19342 MODEL OF AN OSCILLATING COSMOS WHICH REJUVENATES DURING CONTRACTION. Schmidt, Helmut (Boeing Scientific Research Labs., Seattle, Wash.). J. Math. Phys., 7: 494-509(Mar. 1966).

For an oscillating cosmos time-symmetric initial conditions are assumed, invariant under $t \to -t$ and $t \to T + t$, where $t = 0, \pm T, \ldots$ are the times of maximal cosmos contraction. In particular the same value U_0 is specified for the cosmos' "internal energy" U at all these times. The expectation value of an Heisenberg operator is then $\langle Q(t) \rangle = \mathrm{Tr}\,\{Q(t)D\}$, with $D = [A(T),A(0)]_+/2\mathrm{Tr}\,\{A(T)A(0)\}$. Here A(0) is the projector into the space of the eigenvectors of U with eigenvalue U_0, and A(t) has the time dependence of an Heisenberg operator. The time symmetry implies that the

cosmos' oscillations are periodic and that expansions and contractions occur (except for local statistical fluctuations) time-symmetrically to each other: If the entropy increases during expansion then it must decrease during contraction. The general theory is applied to a highly simplified cosmos model in which no star condensation occurs. Assuming here that the initial state contains equal numbers of particles and antiparticles, the theory predicts a slightly inhomogeneous distribution of these particles such that during the cosmos' expansion not all particles annihilate, but a realistic density of particles and antiparticles (in different space regions) survives the expansion. (auth)

19343 MAGNETIC FIELDS IN STELLAR BODIES. I. MAGNETIC FIELDS IN POLYTROPES. Monaghan, J. J. (Churchill Coll., Cambridge, Eng.). Mon. Notic. Roy. Astron. Soc., 131: 105-19(1965).

Using a first order perturbation technique the form of the equilibrium poloidal magnetic field for polytropes is calculated. A special case where the internal field is continuous with an external dipole field is worked out in detail for a wide variety of polytropic indices. The numerical calculations show that the form of the field is relatively insensitive to the polytropic index so that the field calculated for the polytrope is a reasonable approximation to that in a real star. This result is only valid when the magnetic field is a weak perturbation. (auth)

19344 AN OSCILLATING ISOTROPIC UNIVERSE WITHOUT SINGULARITY. Pachner, J. (Astronomical Inst., Prague). Mon. Notic. Roy. Astron. Soc., 131: 173-6(1965).

In the proposed model of an oscillating universe with a uniform and isotropic distribution of matter the absence of a singularity with the infinite density of matter depends essentially on the existence of a negative stress indirectly proportional to the n-th power of the curvature of space and causing the continuous creation of matter. Only the case n = 4 is investigated. The curvature of space depends then on the time by a curtate cycloid. It is found that the differences between this model and the Friedman universe are in the present epoch of the cosmic evolution far below the limit of observability. (auth)

19345 PHYSICAL CONDITIONS IN GASEOUS SPHERES. Ostic, R. G. (Univ. of California, La Jolla). Contract AT(11-1)-34. Mon. Notic. Roy. Astron. Soc., 131: 191-7 (1965). (UCSD-34P43-2).

Calculations as discussed by Bainbridge were re-computed for gaseous spheres consisting of 85.4 per cent hydrogen and 14.6 per cent helium (by volume). A semi-empirical equation of state was used, and it was assumed that the gas is adiabatic and under hydrostatic equilibrium. It is seen that as a gaseous sphere contracts without losing mass, its central density and pressure increase, its total energy decreases, and its central temperature increases to a maximum value, and then decreases. The calculations indicate that a contracting gaseous sphere could provide the high temperatures necessary for differentiation of metals and silicates in a meteorite parent body if the sphere were of mass greater than 2×10^{28} grams, and diamonds could form at the surface of the meteorite parent body only if the sphere were of mass greater than 3×10^{28} grams. (auth)

19346 CHEMICAL EVIDENCE RELATIVE TO THE ORIGIN OF THE SOLAR SYSTEM. Urey, Harold C. (Univ. of California, La Jolla). Contract AT(11-1)-34. Mon. Notic. Roy. Astron. Soc., 131: 199-223(1966). (UCSD-34P43-1).

A theory presented previously is reviewed in the light of recent evidence. Diamonds in meteorites appear to require high steady pressures at some time in their history, the sun still is reported to contain less iron than the terrestrial planets and meteorites, and structures in iron meteorites still indicate that they did not originate from cores of asteroids. These as well as other evidence indicate that fairly large objects of approximately lunar size existed temporarily in the solar system and were destroyed. Fractionation of the metallic and silicate phases occurred leaving higher density materials to form the terrestrial planets. It was and is again suggested that gravitational instability in the solar nebula was the mechanism for the accumulation of the terrestrial planetary materials and for producing objects large enough to produce diamonds, and that adiabatic compression of gases produced the melting of the meteorites. It is suggested again that the moon may be one of these primary objects accumulated in primitive gas spheres and that it is older than the earth. The interaction of a solar magnetic field with ionized gases is accepted as the mechanism for the loss of angular momentum from the primitive sun. (auth)

19347 THE TWO-COLOUR DIAGRAM AS A KEY TO PAST RATES OF STAR FORMATION AND PAST RATES OF METAL ENRICHMENT OF THE INTERSTELLAR MEDIUM. II. Dixon, M. E. (Univ. of Cape Town). Mon. Notic. Roy. Astron. Soc., 131: 325-34(1966).

The two-color diagram for main sequence stars is used to investigate past rates of star formation and past rates of metal enrichment of the interstellar medium. Values are given for the proportion of stars formed during the initial stages in the history of the galaxy, and also for the frequency distribution function for metal abundances in the interstellar medium at the present epoch. (auth)

19348 EXTRAGALACTIC RADIO SOURCES. II. INTERFEROMETRIC DETECTION METHODS IN RADIO-ASTROMONY. Schwarz, U. (Sterrekundig Laboratorium Kapteyn, R. U., Groningen, Netherlands). Ned. Tijdschr. Natuur., 31: 345-69(Oct. 1965). (In Dutch).

Position determination of point sources using interferometers consisting of two identical elements is considered. The theory is then expanded to the case of a non-point source. The results are applied to the detection with more complex antenna systems. One-dimensional antenna synthesis was discussed, and then the extension to two dimensions was considered. The detection of radio sources hidden by the moon is briefly considered. (J.S.R.)

19349 TWO-FLUID MODEL OF THE SOLAR WIND. Sturrock, P. A.; Hartle, R. E. (Ames Research Center, Moffett Field, Calif.). Phys. Rev. Lett., 16: 628-31(Apr. 4, 1966).

A discussion of a two-fluid model of the solar wind for investigating temperatures of protons and electrons and to obtain correct formation of the fluid dynamics is presented. Conventional assumptions of stationary spherically symmetric flow with no rotation or magnetic fields and without viscous stress are incorporated. (B.G.D.)

19350 MEASUREMENTS OF PROTON TEMPERATURES IN THE SOLAR WIND. Strong, I. B.; Asbridge, J. R.; Bame, S. J.; Heckman, H. H.; Hundhausen, A. J. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 16: 631-3(Apr. 4, 1966). (LA-DC-7717).

Preliminary results are presented of measurements of proton temperatures in the solar wind from the electrostatic analyzers on the Vela II satellites which extend the measured temperature range downward and which suggest relations between the temperature, the solar wind velocity, and the terrestrial magnetic disturbance index. (B.G.D.)

19351 SIMULTANEOUS SATELLITE AND GROUND-BASED OBSERVATIONS OF SOLAR PROTONS. Chivers, H. J. A. (Environmental Science Services Administration, Boulder, Colo.); Burrows, J. R. Planet. Space Sci., 14: 131-42(Feb. 1966).

During September 1963 two solar proton events occurred. The particles were detected directly by the satellite Alouette and indirectly, as ionospheric absorption, by a network of riometers distributed in latitude across the northern and southern polar caps of the earth. Since one of the riometers was located at the South Pole, where it was continuously sunlit during the events, the absorption measurements there were unaffected by the usual day-to-night variation. Hence the absorption has been unambiguously compared with the proton flux measured by the satellite, and an empirical relation between the two has

been derived. The riometer records have also been used to indicate continuously the variation of absorption with latitude across the polar caps. These latitude profiles were compared with the latitudinal variation of the proton flux as determined by the satellite, and there is a close correspondence between the profiles obtained for the same time by the two techniques. In particular the change in the cut-off energies following the sudden commencement of a magnetic storm is clearly evident. The "noon-recovery" of the absorption in the polar cap is shown to be compatible with a change in the geomagnetic cut-off at locations near the edge of the polar cap. (auth)

19352 SOLAR WIND BEYOND THE EARTH'S ORBIT. THE TRANSITION ZONE. Faus, A. A. (Univ. College, London). Planet. Space Sci., 14: 143-54(Feb. 1966).

Typical values of the solar wind beyond 1 a.u. are computed. The study of a shock wave formation gives a distance of occurrence at 15–500 a.u. corresponding to 3–0.1 gamma interstellar magnetic field, respectively. It is shown that such a shock wave implies a hot (3×10^6°K) tenuous gas region surrounding the solar system. It is suggested that the solar wind terminates by means of a nonadiabatic free expansion that occurs at 1–3 a.u. where the gas pressure is comparable with the interstellar estimates. The density there becomes also of the same order of magnitude as the interstellar values. The suggested transition zone after comet tail observations occurs at the same distance 1–3 a.u. Also, the neutral interplanetary hydrogen concentration supports this order of magnitude estimate. (auth)

19353 RADIO GALAXIES AND QUASARS. Shakeshaft, J. R. (Cambridge Univ., Eng.). Sci. Progr. (London), 53: 515-28(Oct. 1965).

The present knowledge and understanding of the optical and radio characteristics of radio galaxies and quasi-stellar radio sources is reviewed. (auth)

19354 QUASARS AND QUASI-STELLAR GALAXIES WILL PERHAPS PROVIDE THE KEY TO THE STRUCTURE OF THE UNIVERSE. Lequeux, James (Univ., Paris). Sci. Progr.-Nature, No. 3369, 1-10(Jan. 1966). (In French).

The discovery and significance of quasi-stellar radio-sources and quasi-stellar galaxies (which differ from the quasars only in having no radio emission) are discussed. The different models of the universe are reviewed and the significance of the spectral shift and magnitude on these models is considered. Areas for future study and investigation are indicated. (J.S.R.)

19355 IMPLICATIONS OF SOLAR RADIO BURSTS FOR THE STUDY OF THE SOLAR CORONA. Takakura, T. (Tokyo Univ.). Space Sci. Rev., 5: 80-108(Jan. 1966).

The physical properties of the corona, especially above the active regions, are studied from the observed characteristics of radio bursts which originate in the corona by adopting their most reasonable emission mechanisms. Implications of types I, II, III, and U are discussed, and a review of the estimations of magnetic field intensity in the corona by using radio burst measurements is given. (J.F.P.)

Atomic Physics

Refer also to abstracts 19617, 19670, and 20147.

19356 (CEA-R-2888) PROCESSUS MULTIPHOTONIQUES PROVOQUES PAR UN LASER. (Multiphoton Processes Brought About By a Laser). Nelson, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 24p. Dep. mn.

The critical intensity characterizing the multiphoton processes is calculated. The multiphoton effects corresponding to the Compton scattering, the bremsstrahlung, and the photoelectric effect are investigated. The cross sections are evaluated. It is shown how the introduction of a refractive index, in clothing the photons, allows the elimination of the infrared divergence. The theory seems consistent with experiment. (auth)

19357 (IS-T-64) ELECTRON CORRELATION, PAIR APPROXIMATION AND AUGMENTED PAIR EXPANSION. APPLICATION TO BERYLLIUM-LIKE ATOMIC SYSTEMS [Thesis]. Miller, Kenneth John (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 153p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

A method is developed for determining with the help of the variation principle the best antisymmetrized product of separated geminals for a poly-atomic system. The strongly orthogonal geminals are determined directly in natural form and the natural orbitals are expressed in terms of Slater-type atomic orbitals. An application to the beryllium-like atomic systems uniformly recovers 90 per cent of the correlation energy. Correction for defects in the calculated wavefunctions gives an estimate of 92 per cent for the correlation energy recovered by the best possible separated pair approximation. The correlation energy recovered is analyzed by a partitioning of the energy into intra- and intergeminal contributions, and both are further resolved into natural orbital contributions. Certain contributions from the weakly occupied natural orbitals are negligible for the intrageminal energy lowerings and for the intergeminal interactions. As a further refinement, the augmented separated pair expansion is developed. The wavefunction is expanded in a series of augmented separated pair configurations of which each term is an antisymmetrized product of certain separated geminals. The leading term is the separated pair approximation; the higher terms are also formed from the natural orbitals of the separated pair approximation. The relatively few contributing configurations can be readily classified. In an application to beryllium only 28 of several hundred configurations contribute more than 10^{-5} a.u. The total correlation energy recovered is 94 per cent. Correction of the defect in the wavefunction gives an estimated value of 96 per cent. The additional correlation energy recovered by the augmented separated pair expansion beyond the separated pair approximation can be identified as due to intergeminal interactions. It is analyzed by a partitioning of the energy in terms of interaction between augmented separated pair configurations. (auth)

19358 (N-65-17255) INVESTIGATION OF KILOVOLT ION SPUTTERING. Quarterly Progress Report. Smith, Harold P. Jr.; Hulbut, F. C. (California Univ., Berkeley. Space Sciences Lab.). Jan. 31, 1965. Contract NAS3-5743. 30p. (NASA-CR-54129, Ser. 6, Issue 4). CFSTI $2.00 cy, $0.50 mn.

Final measurements were made to assure that the Cs ion beam is focused and transported from the surface contact source to the target through a series of electrostatic lenses without significant electron contamination or recombination. The problem of focusing and transport of heavy ion beams in the kev energy range received additional study due to anticipated problems with the Hg ion beam which requires magnetic analysis. An adjustable lens system was constructed and tested to study this problem, and an IBM 7094 computer program, adapted to the apparatus, is being used in conjunction with the experimental study. Various components of a suitable time-of-flight apparatus were investigated. The ultra-high-vacuum chamber was able to attain pressures in the low 10^{-10} torr range, while a new ion source was operated at greater than 10 μA. It was found that a small deflection chamber can successfully deflect the beam. (STAR)

19359 (N-65-24388) INVESTIGATION OF KILOVOLT ION SPUTTERING. Quarterly Progress Report. Smith, Harold P. Jr.; Hulbut, F. C. (California Univ., Berkeley. Space Sciences Lab.). Apr. 30, 1965. Contract NAS3-5743. 31p. (NASA-CR-54406). CFSTI $2.00 cy, $0.50 mn.

A radioactive tracer technique was developed and suc-

cessfully applied to the measurement of the yield and angular distribution of copper sputtered from a monocrystalline target under bombardment by a 1- to 10-kev cesium ion beam with the beam parallel to the ⟨100⟩ crystallographic vector. The yield is seen to reach a maximum at 7 kev and is considerably lower than that reported for polycrystalline targets. The relative openness of the (100) face is the probable reason for the significant reduction. A possible application of this effect to ion rocket electrode design is noted. The angular distribution as a function of energy is presented. Preferred ejection in the ⟨100⟩ and ⟨110⟩ directions as well as in the {111} planes is noted. A comparison of the angular distribution with energy of the incident ion is presented and discussed. Further progress in the development of a mercury ion sputtering apparatus and in the time-of-flight velocity spectrum technique is presented. Finally, a suitable collector for activation analysis of sputtered aluminum was tested and found to be satisfactory. (STAR)

19360 (UCRL-16441) I. THE RADIATIVE LIFETIME OF THE MERCURY $^3P_1$ STATE. II. THE LIFETIMES AND SELF-QUENCHING COLLISION CROSS SECTIONS OF FLUORESCENCE FROM VARIOUS v′ REGIONS OF THE $B^3\pi_{0+u}$ STATE OF I_2 [Thesis]. Chutjian, Ara (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 1966. Contract W-7405-eng-48. 106p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The lifetime of the mercury 2537Å $^3P_1 - {}^1S_0$ transition is measured in order to check the performance of the lifetime apparatus described. The measured value is in good agreement with other previous measurements, and the observed increase in lifetime at higher vapor densities is shown to be due to radiation entrapment. The radiative lifetime of eight vibrational levels from v′ = 8 to v′ = 100 in the B state of I_2 were measured, together with $I_1 - I_2$ self-quenching cross sections for each level. Excitation was made both with atomic lines (5461, 5889-95, 5086Å) and narrow band continua. No significant changes in cross section or lifetime were observed when the peak of the continuum excitation corresponded to the atomic line wavelength. The self-quenching cross sections did not vary with vibrational level, whereas the lifetimes vary by as much as a factor of seven. The kinetics of the recombination of iodine atoms is discussed, and the resulting formula for the steady-state concentration of atoms using quenching rates measured in the present work is compared with the single piece of experimental datum available. (auth)

19361 RESONANCES IN ELECTRON SCATTERING AND PHOTON ABSORPTION. Burke, P. G. (Atomic Energy Research Establishment, Harwell, Eng.). Advance. Phys., 14: 521-67(Oct. 1965).

A short survey is given of the development of ideas about resonances in atomic scattering processes and their connection with the theory of resonant states in nuclei, impurity resonances in solids, ion-atom scattering and recombination in plasmas. A detailed discussion of the experimental situation for atomic resonances is then given, followed by a review of the theory of resonance reactions as applied to them. Special attention is given to effective range and quantum defect methods, and to Fano's configuration interaction theory. The theoretical results for line positions shapes and widths are compared with experimental data, and the need for more angular distribution data is emphasized. (auth)

19362 A SYMMETRIC DECOMPOSITION OF THE TWO-ELECTRON WAVE EQUATION FOR FINITE NUCLEAR MASS. Kalotas, T. M. (Univ. of Sussex, Eng.). Austral. J. Phys., 18: 511-20(Dec. 1965).

A complete classification of the state of two-electron atoms is given in terms of a set of symmetrized Euler-angle functions, and the matrix of the kinetic energy derived for this choice of states. For a state of given L, π, P_s the non-relativistic Schrödinger equation reduces to a finite set of coupled equations in the internal coordinates r_1, r_2, r_{12}; these equations are given for arbitrary L, π, P_s. The results apply to atomic two-electron systems with nuclei of finite mass, and more generally to any non-relativistic three-body system in which two of the particles have equal mass. (auth)

19363 SECONDARY ELECTRON EMISSION FROM METAL SURFACES BY IMPACT OF CHARGED AND NEUTRAL LITHIUM PARTICLES. Bethge, K.; Lexa, P. (Univ., Heidelberg). Brit. J. Appl. Phys., 17: 181-6(Feb. 1966).

The second electron emission yield from mechanically cleaned metal foils of Be, Al, Ag, Ta, Pt, Au, W, Cu–Be, and Ag–Mg alloy surfaces bombarded by beams of positively charged and neutral lithium atoms in the energy range 20–60 kev was measured. Comparison measurements were carried out on oxidized and vacuum-heated tungsten surfaces. The secondary emission detector for neutral particle impact was calibrated with a semiconductor thermocouple. The ratio $\gamma_{Li}^{0}/\gamma_{Li}^{+}$ was found to have the value 1.1 ± 10% for all the elements studied, with the exception of Be and Al. (auth)

19364 ON THE CONTINUOUS SPECTRUM OF SCHROEDINGER OPERATORS. Weidmann, Joachim (Univ., Heidelberg). Commun. Pure Appl. Math., 19: 107-10 (Feb. 1966).

It is proven that for n ≧ 1, where n is the number of electrons, the spectrum of the nonrelativistic Schroedinger operator, H, of an atom or ion of arbitrary charge is purely continuous in (0, ∞). An efficient use of the properties of the potential and of the domain of H is given. The nature of the spectrum in (μ, 0), where μ is a negative number, is unknown. (J.F.P.)

19365 CALCULATED ELASTIC SCATTERING CROSS SECTIONS FOR THE H^+–He SYSTEM. Weber, Gunter G.; Gordon, Nahida H.; Bernstein, R. B. (Univ. of Wisconsin, Madison). J. Chem. Phys., 44: 2814-16(Apr. 1, 1966).

The ab initio computations by Michels and Harris, and Peyerimhoff, of the ground ($^1\Sigma^+$) state of HeH^+ provide a reliable interaction potential V (r) to serve as a basis for prediction of proton-helium elastic scattering. Calculations of total elastic cross sections Q(E) for low collision energies (E in the range 0.3 to 200 ev), where Q is sensitive primarily to the attractive part of V (r), are summarized. Superimposed on the monotonic E^- dependence (arising from the long-range r^{-4} "tail" of the potential) are a number of broad extrema in Q(E), characteristic of a potential well with the capacity for several (≧7) bound (vibrational) states. (auth)

19366 SOLUTION OF THE THOMAS-FERMI-DIRAC EQUATION WITH A MODIFIED WEIZSAECKER CORRECTION. Tomishima, Yasuo; Yonei, Katsumi (Okayama Univ., Japan). J. Phys. Soc. Jap., 21: 142-53(Jan. 1966).

According to the result obtained in a previous paper (J. Phys. Soc. Japan 20: 1051 (1965)), the Weizsäcker correction is introduced into the TFD theory with a constant weighting factor λ(=0.2) and this extended statistical equation is solved for the electron distribution of the inert gas atoms Ne, Ar, Kr, and Xe. The values of the total energy calculated on this basis agree very well to the Hartree-Fock values. The diamagnetic susceptibilities, however, still have a poor coincidence although the present model gives definitely better results compared to the simple TF or TFD theory. One-electron energy values of the occupied states in Kr atom are also calculated by the Bohr-Sommerfeld quantization condition. (auth)

19367 TWO-PHOTON DECAY OF SINGLET METASTABLE HELIUM. Dalgarno, A. (Queen's Univ., Belfast). Contract N62558-3634. Mon. Notic. Roy. Astron. Soc., 131: 311-13(1966).

The probability of two-photon decay of helium in the 2^1S metastable level is calculated to be 46 s^{-1}. The intensity distribution of the two-photon continuum is obtained. (auth)

19368 STOPPING CROSS SECTION IN CARBON OF 0.1 TO 0.9-Mev ATOMS WITH $Z_1 \leq 20$. Fastrup, B.; Hvelplund, P.; Sautter, C. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods, 38: 260(1965).

The energy loss of heavy ions with Z = 6 to 20 in penetrating carbon films was measured by means of a magnetic analyzer. Preliminary results for the electron stopping cross section are found to be in good agreement with previous measurements. (L.B.S.)

19369 LARGE-ANGLE COLLISIONS IN AN ALUMINUM SURFACE BOMBARDED BY 50-kev ARGON IONS. Dahl, P. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods, 38: 261-2(1965).

The ejection of charged atomic particles from the surface of an Al target during irradiation by 50 kev Ar^+ ions was analyzed. From accurate measurements of peak positions in the spectra, the inelastic energy loss was obtained assuming pure single collisions, and the results are shown. The atom densities that would account for the measured peak intensities were derived by applying theoretical scattering cross sections. (L.B.S.)

19370 A SIMPLE THEORY OF SINGLE-CRYSTAL SPUTTERING. Lehmann, Chr. (Kernforschungsanlage, Juelich, Ger.). Nucl. Instrum. Methods, 38: 263-8 (1965).

A simple model is given for calculating the sputtering yield of single crystals as a function of the bombarding energy E for low-indexed bombarding directions. In a hard sphere approximation the transparency of the lattice for the penetrating ions is taken into account and the concept of focusing collisions is employed. Focusing collisions are assumed to be responsible for the highly anisotropic emission of surface atoms. Other than the atomic interaction potential no fitting parameters are used. As an example, the sputtering yield is calculated for the bombardment of Cu with Cu-ions for normal incidence onto (110)- (100)- and (111)-surfaces and for energies ranging from 1–5 kev. The result is compared with experimental data. (auth)

19371 THE VALIDITY OF THE TRANSPARENCY MODEL FOR SINGLE-CRYSTAL SPUTTERING. Onderdelinden, D.; Saris, F. W.; Rol, P. K. (FOM-Laboratorium voor Massascheiding, Amsterdam). Nucl. Instrum. Methods, 38: 269-70(1965).

In order to investigate the influence of the mass of metal atoms and the lattice parameter on sputtering yield for single crystals experiments were performed on Al, Au, Pb, and Cu, in which the sputtering ratio was measured as a function of the angle of incidence for 20 kev Ar^+ ions. The results show that minima in the sputtering ratio are found in the [100], [211] and [411] directions. The main difference in behavior of the four metals is the relatively smaller difference between the maximum and minimum values for Al. The large differences in mass and lattice parameters showed no remarkable difference in the behavior of the sputtering ratio. (L.B.S.)

19372 SPUTTERING OF ORIENTED GOLD FOILS BY NOBLE GAS IONS. Drentje, S. A. (Rijksuniversiteit, Groningen, Netherlands). Nucl. Instrum. Methods, 38: 271-3(1965).

Oriented gold foils, prepared by epitaxial growth on LiF and mica, are sputtered by noble gas ions in the energy range 30–100 kev. The sputtering deposits show maxima caused by focused atomic collisions along low index crystal directions, similar to those found by Nelson and Thompson. (auth)

19373 ON THE EXCITED STATE OF SPUTTERED PARTICLES. Van Der Weg, W. F.; Rol, P. K. (FOM-Laboratory for Mass Separation, Amsterdam). Nucl. Instrum. Methods, 38: 274-6(1965).

The possible electronic transitions of ionized and excited atoms at small distances from metal surfaces are investigated and the results are applied to sputtered copper atoms. It is assumed that sputtered ions and excited atoms are converted into atoms in the ground state by resonance processes. The large abundance of excited sputtered particles in the case of oxides is ascribed to the occurrence of forbidden energy gaps in the oxide, which make resonance transitions less probable. (auth)

19374 MUON CAPTURE IN LIQUID HYDROGEN. A COMPARISON BETWEEN THEORY AND EXPERIMENTS. Ohtsubo, H. (Tokyo Inst. of Tech.); Fujii, A. Nuovo Cimento (10), 42A: 109-25(1966).

A precision computation is performed for the atomic and molecular capture rates of the muon in liquid hydrogen. With the following dynamical assumptions: i) the universality of the electron and muon weak interactions, ii) time reversal invariance, iii) hypothesis of conserved vector current, iv) hypothesis of asymptotically conserved axial vector current and v) the definite G-parity of the nucleon weak current, the molecular capture rate in liquid hydrogen is calculated and compared with the experiment. Within the experimental error the theoretical predictions are generally in good agreement with the experiment. However, by taking the experimental data somewhat strictly, several observations and conjectures are made when some of the above assumptions are abandoned. In particular, discarding the assumption of the definite G-parity of the nucleon current it is found that the induced tensor interaction is appreciable and is not inconsistent with the results obtained in the analysis of the ft-value ratio of ^{12}N to ^{12}B beta decays. On the other hand, the specific breakdown of the time reversal invariance on the octet model is not consistent with the experiment. (auth)

19375 THE PRODUCTION OF POLARIZED ELECTRON BEAMS BY SPIN-EXCHANGE COLLISIONS. Farago, P. S. (Univ. of Edinburgh); Siegmann, H. Chr. Phys. Lett., 20: 279-80(Feb. 15, 1966).

The production of a pulsed beam of polarized electrons is described. 10% electron polarizations were at a peak intensity of 0.01 μA in pulses of a few μsec length and 100 sec^{-1} repetition rate. (auth)

19376 SPIN POLARIZATION OF 300 ev-ELECTRONS FROM ELASTIC SCATTERING ON A SOLID Hg TARGET. Loth, R.; Eckstein, W. (Univ., Mainz. Univ., Munich). Phys. Lett., 20: 390-1(Mar. 1, 1966). (In German).

Spin polarization $P(\theta)$ of 300 ev-electrons elastically scattered by a solid Hg-target was measured in a double scattering experiment. $P(\theta)$-values obtained are smaller by a factor two than those found in scattering by an atomic beam of mercury. (auth)

19377 MEAN LIFE OF THE $2p^2\ ^1D_2$ LEVEL IN OXYGEN(V). Bickel, W. S.; Bashkin, S. (Univ. of Arizona, Tucson). Phys. Lett., 20: 488-9(Mar. 15, 1966).

The mean life of the $2p^2\ ^1D_2$ level in OV was measured by the beam-foil technique. The value is $1.36 \pm 0.01 \times 10^{-9}$ sec. (auth)

19378 ADDITIONAL MEASUREMENTS OF THE VELOCITY DEPENDENCE OF TOTAL COLLISION CROSS SECTIONS FOR THE SCATTERING OF H_2 AND D_2 MOLECULAR BEAMS ON RARE GASES. Feltgen, R.; Gaide, W.; Helbing, R.; Pauly, H. (Univ., Bonn). Phys. Lett., 20: 501-2(Mar. 15, 1966). (In German).

Measurements of the velocity dependence of total collision cross sections for H_2- and D_2-molecules scattered by rare gases are compared with quantum mechanical calculations (averaged over the velocity distribution of the target particles) for a Lennard-Jones-(12,6)-potential. (auth)

19379 LIFETIME, COHERENCE NARROWING, AND HYPERFINE STRUCTURE OF THE $(6s^26p7s)^3P_1^0$ STATE IN LEAD. Saloman, E. B.; Happer, W. (Columbia Univ., New York). Phys. Rev., 144: 7-22(Apr. 8, 1966).

The lifetime and hyperfine structure of the $(6S^26p7s)^3P_1^0$ excited state in lead was investigated by the technique of level-crossing spectroscopy. The lifetime of the state was determined to be $\tau = 5.75\ (20) \times 10^{-9}$ sec. The linewidth of the level-crossing signal was observed to saturate at a "coherence-narrowed" value in agreement with theoretical predictions. The magnitude of this narrowing corresponds to a 27 (3)% branching ratio to the ground state. When the branching ratio and the lifetime are combined with the f(3639 Å) : f(4058 Å) oscillator-strength ratio

measured by Khokhlov, one may infer the absolute f values: f(2833 Å) = 0.169(17), f(3639 Å) = 0.040(8), f(4058 Å) = 0.155(31). The high-field level crossing in the hyperfine structure of the first $^3P_1^0$ state of ^{207}Pb was found to occur at a magnetic field H_c = 4661.1(4) G, which corresponds to a magnetic-dipole-interaction constant A = 8.811(17) × 10^9 cps. (auth)

19380 LIFETIME OF THE $(6s^26p8s)^3P_1^0$ STATE IN LEAD. Saloman, E. B. (Columbia Univ., New York). Contract DA-28-043 AMC-00099(E). Phys. Rev., 144: 23-4(Apr. 8, 1966).

Hanle-effect studies were made in the $(6s^26p8s)^3P_1^0$ state of lead. ^{208}Pb atoms were excited to this state by 2053-Å lead resonance light, and the 5201-Å cross-fluorescent line from this state was detected. The width of the level-crossing signal corresponds to a lifetime for this state of 1.29(14) × 10^{-8} sec where the quoted uncertainty is three times the standard deviation. This value is a factor of four longer than the value calculated from the oscillator strengths of Corliss and Bozman. (auth)

19381 THEORY OF LOW-ENERGY POSITRON-HELIUM SCATTERING. Drachman, Richard J. (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 144: 25-8 (Apr. 8, 1966).

A modified adiabatic method, previously tested in positron-hydrogen scattering, was applied to the case of positron-helium scattering below the positronium threshold (17.8 ev). Since the ratio of the positron's velocity to that of the atomic electrons is about the same as in the hydrogen test case, similar accuracy is expected, the main source of error being the approximate atomic wave function used. Phase shifts for L = 0,1,2 are presented, and total and momentum-transfer cross sections are computed. The latter disagree completely with the only experiments performed to date. (auth)

19382 ASYMPTOTIC BEHAVIOR OF THE BORN SCATTERING AMPLITUDES IN COLLISIONS OF ELECTRONS WITH HYDROGEN ATOMS. Kang, Ik-Ju (Univ. of Massachusetts, Amherst). Phys. Rev., 144: 29-38(Apr. 8, 1966).

The inelastic Born amplitudes for scattering of an electron by a hydrogen atom are obtained, using spherical coordinates, for processes from any initial state to any final state of a hydrogen atom, $(n_0,l_0,m_{0_0}) \rightarrow (n,l,m_l)$ in terms of differential operators, which depend on the quantum numbers of the states involved, and which act on certain simple functions of electron momenta. The amplitudes 1s → 1s and 1s → 2p,m (m = +1,0, −1) are evaluated from the general expression, and found to be in agreement with previous work except for the exchange amplitude for 1s → 2p,±1. The threshold behavior of the cross sections for arbitrary inelastic processes is found to be proportional to the $(2|\Delta m|+1)$th power of the momentum of the outgoing electron. From the investigation of the high-energy behavior of the amplitudes, it is also found that while the Ochkur relation is valid, so that the direct scattering mode is dominant over the exchange mode for large-angle scattering, the exchange scattering is dominant for very-small-angle scattering processes, involving large principal and angular-momentum quantum numbers. (auth)

19383 MANY-BODY PERTURBATION THEORY APPLIED TO OPEN-SHELL ATOMS. Kelly, Hugh P. (Univ. of California, San Diego, La Jolla). Phys. Rev., 144: 39-55(Apr. 8, 1966).

It is shown how many-body perturbation theory may be applied to the problem of correcting Hartree-Fock energies and wave functions for the degenerate ground states of open-shell atoms. The choice of an appropriate potential for the calculation of the single-particle states of the perturbation expansion is discussed in detail. As an example of these methods, the correlation energies among all pairs of electrons in the neutral oxygen atom are calculated for excitations into l = 0, 1, 2, and 3 states. The total calculated pair correlation energy is −0.274 atomic units (a.u.) as compared with the total correlation energy −0.258 a.u., which is deduced from experiment. The correlation energy among 2p-2p electron pairs is −0.0906 a.u., among 2s-2p pairs, −0.1004 a.u.; 2s-2s, −0.0150 a.u.; 1s-2p, −0.014996 a.u.; 1s-2s, −0.00629 a.u.; 1s-1s, −0.0438 a.u. There is also a contribution −0.0028 a.u. which corrects for the use of a restricted Hartree-Fock solution. (auth)

19384 RESONANCE IN ELECTRON CAPTURE BY A PROTON FROM A HYDROGEN ATOM. Basu, D.; Sil, N. C.; Bhattacharya, D. M. (Indian Association for the Cultivation of Science, Calcutta). Phys. Rev., 144: 56-9 (Apr. 8, 1966).

The probability of electron capture by a proton from a hydrogen atom was calculated for a fixed scattering angle and for low incident proton energies using a variational method with a trial wave function in which only the 1s and 2s electron states around the two nuclei are retained. The resulting coupled differential equations with appropriate initial conditions were solved numerically; the results of our theoretical calculations for the capture probability at an angle of scattering of 3° (laboratory system) for various incident proton energies were compared with the experimental findings of Lockwood and Everhart. (auth)

19385 PRESSURE EFFECTS OF FOREIGN GASES ON THE ABSORPTION LINES OF CESIUM. I. THE EFFECTS OF ARGON ON THE FIRST TWO MEMBERS OF THE PRINCIPAL SERIES. Ch'en, Shang Yi; Garrett, Robert O. (Univ. of Oregon, Eugene). Phys. Rev., 144: 59-65(Apr. 8, 1966).

The effect of Ar on both fine-structure components of the first two members of the Cs principal series is described. Experimental procedures are outlined. Cs(1)/Ar and Cs(2)/Ar measurements are reported up to 300 and 30 atmospheres, respectively. Special emphasis was given to obtaining precise data in the low-pressure region. This emphasis revealed structure heretofore unsuspected. In particular, the plot of half-widths versus argon density is nonlinear at low pressures, in contradiction to the present theory. Also, it is found that similar plots for shifts, although linear initially, deviate sharply from the original line at quite low pressures. After a transition region the shift curves are all observed to have a second linear region. The observed anomalous shift and broadening may be due to the effect of unresolved satellite bands of the lines. (auth)

19386 PRESSURE EFFECTS OF FOREIGN GASES ON THE ABSORPTION LINES OF CESIUM. II. THE EFFECTS OF HELIUM ON THE FIRST TWO MEMBERS OF THE PRINCIPAL SERIES. Garrett, Robert O.; Ch'en, Shang Yi (Univ. of Oregon, Eugene). Phys. Rev., 144: 66-70(Apr. 8, 1966).

Cs(1)/He and Cs(2)/He measurements are reported up to 300 and 20 atmospheres, respectively. The shift curves for Cs(1)/He are linear up to a point and then very abruptly change to a new linear region. Half-width curves are all observed to be nonlinear at low pressures. In addition, the half-widths of helium-broadened cesium lines are shown to have a strong temperature dependence, at least as strong as the first power of temperature. There is very little or no temperature effect on the shift within our temperature and pressure range of experimental observations, viz. 40°C−160°C and relative density 0−190 for Cs(1)/He, and 98°C−177°C, and relative density 0−13 for Cs(2)/He. (auth)

19387 ABSENCE OF QUASIBOUND NEGATIVE-ION GROUND STATES OF He AND H_2 IN ELECTRON SCATTERING. Golden, D. E.; Nakano, H. (Lockheed Aircraft Corp., Palo Alto, Calif.). Phys. Rev., 144: 71-4(Apr. 8, 1966).

A search for quasibound negative-ion ground states in electron scattering from He and H_2 in transmission was made with negative results. The half-width of the electron beam used in these experiments was about 0.05 ev and was independent of electron energy in the interaction re-

gion. The lower limit for detection of cross-section changes in this experiment was about 2 or 3 parts in 10^4. The series of elastic vibrational resonances in N_2, which are probably due to the quasibound negative-ion ground state of N_2, are discussed. (auth)

19388 EXCITATION OF n = 2 STATES IN HELIUM BY ELECTRON BOMBARDMENT. Holt, Helen K.; Krotkov, R. (Yale Univ., New Haven). Phys. Rev., 144: 82-93(Apr. 8, 1966).

The total cross section for excitation of the 2^1S state in helium by electron bombardment was measured, together with the sum of the 2^3S and 2^3P cross sections. Singlet metastable atoms were distinguished from triplet ones by quenching the singlets in an electric field. An estimate of the 2^3P cross section is made. All measurements were relative to the peak of the 2^3S cross section, and covered the energy range 19.8 to 23.2 ev. Assuming a value of $(3.0 \pm 0.7) \times 10^{-18}$ cm^2 for this peak, the 2^1S cross section was found to rise from threshold to a plateau at $(1.0 \pm 0.3) \times 10^{-18}$ cm^2. The 2^3P cross section rises steadily from threshold to $(3.0 \pm 1.0) \times 10^{-18}$ cm^2 at 23.2 ev. Measurements were also made of the relative populations of the magnetic substates of the 2^3S state. These are related to the polarization of the collision light emitted in the $2^3P \rightarrow 2^3S$ decay and were motivated by the well-known polarization anomaly. For about 2 v above the 2^3P threshold the measured tensor polarization has the constant value -0.06 ± 0.06, which may be compared with a predicted threshold value of -0.55. This result is interpreted in terms of resonance structure. (auth)

19389 SPECTRA OF X-RAY ABSORPTION IN THE K SHELL OF Si IN GASEOUS $SiCl_4$ AND IN THE L SHELL OF Ge IN GASEOUS $GeCl_4$. Mott, David L. (New Mexico State Univ., University Park). Phys. Rev., 144: 94-6 (Apr. 8, 1966).

The K absorption spectrum of Si in $SiCl_4$ gas and the L absorption spectrum of Ge in $GeCl_4$ gas were measured using a two-crystal vacuum spectrometer with potassium acid phthalate crystals. The Si K absorption spectrum has fine structure quite similar to that of the well-known Ge K absorption spectrum of $GeCl_4$ gas. From the fine structure of the Ge L absorption spectrum it can be concluded that bound-ejected-electron states of several symmetries exist in the $GeCl_4$ gas molecule. (auth)

19390 LIFETIMES AND g_J FACTORS IN EXCITED STATES OF CHROMIUM. HYPERFINE STRUCTURE OF ^{53}Cr. Bucka, H.; Budick, B.; Goshen, R. J.; Marcus, S. (Columbia Univ., New York). Contract DA-36-039 SC-90789. Phys. Rev., 144: 96-102(Apr. 8, 1966).

The ^7P terms of two excited chromium configurations were studied by the techniques of level-crossing and double-resonance spectroscopy. The lifetimes of the J levels of the two terms were found by observation of the Hanle effect to be $(3.34 \pm 0.5) \times 10^{-8}$ sec and $(6.51 \pm 0.9) \times 10^{-9}$ sec for $(3d^54p)^7P_4$ and $(3d^44s4p)^7P_4$, respectively. g_J values for the three J levels of the $(3d^54p)^7P$ term were also determined: $g(J = 4) = 1.7512(3)$, $g(J = 3) = 1.9178(2)$, and $g(J = 2) = 2.3351(3)$. For the purpose of studying core polarization in chromium, measurements were made of the magnetic hyperfine constants in both configurations. For $3d^54p$, $|a(J = 4)| = 11.6 \pm 0.15$ Mc/sec, $|a(J = 3)| \leq 1.5 \pm 2.0$ Mc/sec, $|a(J = 2)| = 26.16 \pm 0.10$ Mc/sec, and for $3d^44s4p$, $|a(J = 3)| = 70.4 \pm 2.6$ Mc/sec. (auth)

19391 CORE POLARIZATION IN ^{53}Cr. Budick, B.; Goshen, R. J.; Jacobs, S.; Marcus, S. (Columbia Univ., New York). Contract DA-36-039 SC-90789. Phys. Rev., 144: 103-9(Apr. 8, 1966).

Theoretical and experimental values for the contribution of core polarization to the hyperfine structure of excited states of ^{53}Cr are compared. A theory is developed for extracting the core contributions to the magnetic field from the measured hyperfine constants. It is necessary to take account of configuration interaction with an actual configuration of unpaired s electrons. A value of $-525{,}000$ is deduced for the magnetic field at the nucleus produced by core polarization. The minus sign indicates that this field is antiparallel to the net spin of the atom. This is compared with theory and with the results of other experiments. Corrections due to relativity, the second-order Zeeman effect, and the breakdown of LS coupling are considered. (auth)

19392 ELASTIC DIFFERENTIAL SCATTERING OF He^+ IONS BY Ne AND Ar AND OF Ar^+ IONS BY Ar IN THE 10- TO 600-ev RANGE. Aberth, William; Lorents, Donald C. (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., 144: 109-15(Apr. 8, 1966).

Absolute elastic differential scattering cross sections of He^+ on Ne and Ar and of Ar^+ on Ar were measured at relative energies ranging from 10 to 600 ev and scattering angles of 1° to 40°. The He^+ on Ne and Ar cross sections are monotonically decreasing functions of angle and have a superimposed ripple structure which is attributed to curve-crossing effects. No rainbow-angle structure is evident on these curves. The Ar^+-on-Ar cross sections indicate both rainbow scattering and oscillations associated with symmetric charge exchange. From the values of the rainbow scattering angle, the estimated binding energy of Ar_2^+ is 1.6 ± 0.3 ev, assuming the general shape of the attractive potential resembles that of He_2^+. (auth)

19393 DETERMINATION OF ELECTRON ENERGY LOSSES IN RUBIDIUM. Hartley, B. M.; Swan, J. B. (Univ. of Western Australia, Nedlands). Phys. Rev., 144: 295-7 (Apr. 8, 1966).

Surface and volume plasmon energies of 2.4 and 3.45 ev, and energy losses of 25 and 55 ev, are measured in the characteristic electron energy-loss spectra of rubidium. A computer program used to determine peak positions and evaluate energy losses is described. (auth)

19394 RETROFUGAL ELECTRON FLUX FROM MASSIVE TARGETS IRRADIATED WITH A MONOENERGETIC PRIMARY BEAM. Dressel, Ralph W. (New Mexico State Univ., University Park. Nuclear Effects Lab., White Sands Missile Range, N. Mex.). Phys. Rev., 144: 332-43(Apr. 8, 1966).

Nearly monoenergetic electrons in a collimated beam were directed at normal incidence onto a variety of thick targets ranging in atomic number from Be to U. The ratio $r(\theta, E_0, Z)$ of the number of retrofugal (i.e., energetic secondary plus backscattered primary) electrons per steradian to the number of incident primaries was measured for a total of 11 targets. The mean energy E_0 of the incident electrons was varied from 0.5 to 10 Mev and the dependence of r upon θ explored for angles between 90° and 180° with respect to the forward beam axis. For targets having $Z \geq 29$ the angular distributions are independent of E_0 and are described by $\cos^{1.35}\theta$; but for targets with $Z \leq 13$, $r(\theta, E_0, Z)$ depends upon all three parameters. Typical values obtained for the retrofugal flux coefficient range from r(180°, 10 Mev, 4) = 1.2 milliunits/steradian for Be to r(180°, 0.5 Mev, 92) = 274 for U. These generally are higher than those reported previously. (auth)

19395 ENERGY SPECTRA OF THE RETROFUGAL ELECTRON FLUX FROM MASSIVE TARGETS. Dressel, Ralph W. (New Mexico State Univ., University Park. Nuclear Effects Lab., White Sands Missile Range, N. Mex.). Phys. Rev., 144: 344-9(Apr. 8, 1966).

Electrons from a linear accelerator were directed in a collimated beam at normal incidence upon thick targets of C, Al, Cu, Ag, W, Pb, and U. Energy spectra of the retrofugal electrons were obtained at 155° for seven distinct values of incident-electron energy between 1 and 10 Mev. For all targets, the measured spectra extend from 0.16 Mev to the incident energy E_0. Each spectrum profile has a broad but well-defined maximum at $E = E_w$ which progressively shifts toward higher energy as the incident-electron energy E_0 is increased but which eventually reaches an upper limit determined by the target atomic number Z. For Z = 6 the upper limit of E_w is 0.55 Mev, while for Z = 92 it is 3.0 Mev. An elastically scattered component which is strongly dependent upon both Z and E_0 also can be identified. (auth)

19396 STOPPING POWER OF M ELECTRONS. Khandelwal, G. S.; Merzbacher, E. (Univ. of North Carolina, Chapel Hill). Phys. Rev., 144: 349-52(Apr. 8, 1966).

Explicit formulas are obtained for the atomic M-shell form factor as a function of energy loss and momentum transfer of a charged particle in the Bethe-Born approximation. The M-shell binding corrections to Bethe's energy-loss formula are calculated. The validity of the calculation is limited by the use of hydrogenic wave functions. (auth)

19397 IMPORTANCE OF RELATIVISTIC EFFECTS IN THE SCATTERING OF SLOW ELECTRONS. Browne, H. N.; Bauer, E. (Michelson Lab., China Lake, Calif.). Phys. Rev. Lett., 16: 495-8(Mar. 21, 1966).

The scattering of low-energy electrons was studied using the static central field approximation. Numerical calculations were made of the total scattering cross sections of Cs, He, Kr, and Hg for 2-, 20-, and 200-ev electrons. It was concluded that relativistic effects must be taken into account in the calculation of the scattering cross sections of heavy atoms for low-energy electrons. (D.C.W.)

19398 SINGLE AND DOUBLE IONIZATION OF He BY ELECTRONS. Mittleman, Marvin H. (Univ. of California, Livermore). Phys. Rev. Lett., 16: 498-9(Mar. 21, 1966).

The ratio of the probabilities of single and double ionization of He by high-energy electrons was calculated using the Hartree-Fock approximation, and the result was compared with some experimental values. The theoretical value was about 10% too high. (D.C.W.)

19399 TWO QUANTUM PROCESSES IN THE HARTREE-FOCK APPROXIMATION. Dalgarno, A.; Victor, G. A. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 87: 371-4(Feb. 1966).

A Hartree–Fock approximation scheme is developed for the calculation of the efficiencies of multi-photon processes. It is applied to the calculation of the probability of two-photon radiative decay of singlet metastable helium with a resulting lifetime of 1.2×10^{-2} sec which is within a factor of 2 of the most accurate available estimate, 2.2×10^{-2} sec. (auth)

19400 IONIZATION OF SODIUM AND MAGNESIUM BY ELECTRON AND PROTON IMPACT. Peach, G. (London Univ.). Proc. Phys. Soc. (London), 87: 375-80(Feb. 1966).

The methods developed previously to study the ionization cross sections of H, He, Li and Be in their ground states using the Born approximation were used to extend these calculations to neutral systems with outer 3s electrons. The results obtained are qualitatively similar to those for lithium and beryllium and, in the case of sodium, good agreement is obtained with the recent calculations of Bates, Boyd and Prasad. (auth)

19401 HIGH-ENERGY CROSS SECTIONS FOR ELECTRON EXCITATIONS OF EXCITED HYDROGEN ATOMS IN WHICH THE PRINCIPAL QUANTUM NUMBER IS CHANGED BY 1. Kingston, A. E.; Lauer, J. E. (Univ. of Colorado, Boulder). Proc. Phys. Soc. (London), 87: 399-405(Feb. 1966).

At large impact energies E the cross section Q for the electron excitation from the n, l state of hydrogen to the n′, l′ state may be written in the form $QE = A \log E + B$. The first Born approximation is used to calculate these A's and B's for all transitions with n = 1, 2, 3, 4, 5 and 6 and with $n' = n + 1$. The A's and B's associated with the main optically allowed transitions (i.e., $l' = l + 1$ are largest. However, for small values of l it is found that in calculating the B's all other transitions must be taken into account, besides the main optically allowed transitions, for the sum total effect of these minor transitions is almost as large as that of the main optically allowed transitions. These minor transitions can be neglected in calculating the A's for the average cross section from one energy level to another but they increase the B's for the average cross sections by about 25%. (auth)

19402 COMMENTS ON A PAPER BY KAY, "THE IDENTIFICATION OF EMISSION LINES FROM A VAN DE GRAAFF BEAM." Bashkin, S. (Univ. of Arizona, Tucson); Malmberg, P. R. Proc. Phys. Soc. (London), 87: 589-90(Feb. 1966).

Kay's method of deducing the stage of ionization from which atomic spectral lines are emitted is found to be unsatisfactory on several grounds. (auth)

19403 IMPROVED ATOM PRODUCTION TECHNIQUE. Rony, Peter R. (Univ. of California, Berkeley). Rev. Sci. Instrum., 37: 532-3(Apr. 1966).

The adaptation and simplification of a technique used in plasma physics—the cyclotron resonant discharge—to the production of atomic hydrogen in low pressure systems are reported. (L.B.S.)

19404 DETERMINATION OF THE EFFECTIVE IONIZATION CROSS SECTIONS IN CONDENSED MOLECULAR BEAMS. Hagena, Otto-Friedrich; Henkes, Wolfgang (Technische Hochschule, Karlsruhe, Ger.). Z. Naturforsch., 20a: 1344-8(Oct. 1965). (In German).

Clusters of condensed CO_2 molecules that form a "condensed molecular beam" are ionized by electron impact in the energy range $40 < E_{el} < 580$ ev. The average size of clusters is controlled by the pressure p_0 of CO_2-gas in the nozzle of the beam source. By calibrating the apparatus with uncondensed N_2-beams the ion currents can be converted into an effective cross section σ_{eff} for ionization per molecule contained within the clusters relative to the corresponding cross section σ_0 of uncondensed CO_2. In the range covered by the experimental parameters it is found that always $\sigma_{eff} \leqq \sigma_0$. With increasing size of clusters σ_{eff} tends to decrease and its maximum as function of electron energy moves to higher energies. At the highest value of p_0 $\sigma_{eff} = 0.31$ σ_0 for $E_{el} = 150$ ev, and the maximum of σ_{eff} is situated at 290 ev compared to 95 ev for uncondensed CO_2. (auth)

19405 THE K-AUGER SPECTRUM OF NEON. Koerber, H.; Mehlhorn, W. (Univ., Muenster, Ger.). Z. Phys, 191: 217-30(1966). (In German).

The KLL-Auger spectrum of neon was investigated with an electrostatic spectrometer with an energy resolution of 0.12%. The ionization in the K-shell was caused by electron impact. The use of a gaseous target made it possible to measure the Auger electrons without any energy loss. The relative intensities of the KLL-lines were determined to be: $KL_1L_1(^1S_0) = 1.0$; $KL_1L_{2,3}(^1P_1) = 3.06 \pm 0.07$; $KL_1L_{2,3}(^3Po_{0,1,2}) = 0.98 \pm 0.05$; $KL_{2,3}L_{2,3}(^1S_0) = 1.67 \pm 0.08$; $KL_{2,3}L_{2,3}(^1D_2) = 13.1 \pm 0.6$; $KL_{2,3}L_{2,3}(^2P_{0,2}) = 0$. This is in agreement with an earlier measurement by Körber and Mehlhorn but disagrees with all theoretical values calculated nonrelativistically for low Z. It is shown that agreement may be achieved by applying quantitatively the configuration interaction, introduced very recently by Asaad, and using improved wave functions for the calculation of the transition amplitudes. As a consequence of the ionization by electron impact also the KL-LLL Auger spectrum was caused. Ten lines of this spectrum were measured and identified. Moreover from the Auger energies measured, the binding energy E(K) of neon was calculated to be $E(K) = (870.0 \pm 0.4)$ ev. (auth)

19406 THE KLL-AUGER-SPECTRUM FOR $10 \leq Z \leq 36$. Mehlhorn, W.; Asaad, W. N. (Univ., Muenster, Ger. Cairo Univ.). Z. Phys., 191: 231-47(1966). (In German).

The configuration interation, applied very recently by Asaad to the calculations of KLL-Auger spectra, could remove the large discrepancies which existed for low Z between experimental and theoretical relative group intensities $I(KL_1L_{2,3})/I(KL_1L_1)$ and $I(KL_{2,3}L_{2,3})/I(KL_1L_1)$. Asaad's calculations, however, were based on binding energies $E(L_1)$ and energies of the Coulomb and spin-orbit interaction, which were not very accurate. In the present calculations use was made of more accurate binding energies $E(L_1)$ and Coulomb and spin-orbit interaction energies. It is shown that the absolute error in the results of the new calculations is less than 10%. From this it follows that the

remaining discrepancies between theoretical and experimental values of the group intensities for $10 \leq Z < 25$ may be solely attributed to the inadequacy of the calculated transition probabilities. This calls for calculations of transition amplitudes of the KLL-process with more accurate wave functions for $Z < 25$, in particular for $Z = 10$. (auth)

19407 SPUTTERING CALCULATIONS FROM A REALISTIC MODEL [Thesis]. Schlaug, Robert Noel. Berkeley, Calif., Univ. of California, 1965. 228p.

Sputtering yields are calculated for copper, argon, and cesium ions (with energies ranging from near threshold values to 10 kev) normally incident on the (100) face of a simulated copper crystal in which the lattice atoms are assumed to be at their normal fcc lattice positions. The threshold energy and threshold mechanism are determined for each bombarding ion. Two different threshold mechanisms are important: one dominant for projectile-target atom mass ratios greater than one and the other for mass ratios less than one. Binary collisions are used whenever the moving particles have an energy greater than 300 ev. Moving atoms with a lower energy that are close to the crystal surface to cause a sputtered atom by the most optimum process (initiation of a ⟨110⟩ focusing chain) fall into the following classes: (1) the atom initiates a ⟨110⟩ focusing chain, or (2) the atom passes through a lens, composed of three or four atoms, perpendicular to the ⟨111⟩ or ⟨100⟩ directions respectively. Focusing chains directed toward the surface are treated by a modified binary collision method, which includes energy losses to the neighboring atom rows. Otherwise, the atom travels through a lens section containing only those lattice atoms lying in the lens direction. The simultaneous motions of these atoms are calculated from a central difference solution of the Newtonian equations of motion. Atoms leaving the crystal surface must, in addition, overcome a directionally independent surface barrier. The calculated yields are reported for surface barrier heights ranging from two-thirds to twice the cohesive energy of copper (3.52 ev). The deviation of the calculated yield curves from the available experimental data is largely explainable from uncertainties in the barrier height and Born-Mayer potential parameters. (Dissertation Abstr.)

Cosmic Radiation

See also Elementary Particles and Radiations
Nuclear Properties and Reactions

Refer also to abstracts 19028, 19030, and 19494.

19408 (ANL–7130, pp 373-92) THE CASE-WITWATERSRAND UNDERGROUND NEUTRINO PROGRAM. Crouch, M. F.; Gurr, H. S.; Jenkins, T. L.; Kropp, W. R.; Reines, F.; Smith, G. R. (Case Inst. of Tech., Cleveland, Ohio); Meyer, B.; Sellschop, J. P. F. (University of the Witwatersrand, Johannesburg (South Africa)).

The status of the Case-Wits deep underground experimental program which is aimed primarily at the study of neutrinos arising from the interaction of cosmic rays with the atmosphere and secondarily at neutrinos from the sun is reported. Preliminary results taken are presented. (M.O.W.)

19409 (ANL–7130, pp 393-405) COSMIC-RAY NEUTRINOS. Keuffel, J. W. (Utah Univ., Salt Lake City).

Experiments which are presently being done in the high-energy cosmic-neutrino field are outlined. The type of data which may be expected in the immediate future is discussed. The University of Durham-Tata Institute–Osaka City University collaboration experiment in the Kolar Gold Fields in India is discussed. Brief mention is made of the University of Utah detector now in the prototype testing stage. (M.O.W.)

19410 EFFECT OF GRAVITATION IN THE ORIGIN OF COSMIC PARTICLES. Durgapal, M. C.; Gehlot, G. L. (Univ. of Jodhpur, India). Austral. J. Phys., 18: 655-60 (Dec. 1965).

Following on Infeld's proposal of the dependence of the physical constants on the gravitational field, this idea is applied to quantum mechanics and other physical phenomena and a possible explanation of the origin of cosmic rays is suggested. (auth)

19411 A STUDY OF HIGH-ENERGY NUCLEAR INTERACTIONS WITH A LARGE EMULSION CLOUD CHAMBER. Maeda, Yasuko (Kobe Univ., Japan). J. Phys. Soc. Jap., 21: 1-13(Jan. 1966).

A large emulsion cloud chamber (E.C.C.) carried by a balloon was exposed at high altitude (October, 1963, Kobe). The characteristics of the interactions of high energy cosmic ray particles ($\gtrsim 10^{13}$ev) with other nuclei were examined. Forty-two events with energies higher than 10^{12}ev were observed, from which the events of nuclear interactions in the carbon producer were selected. The transverse momenta of γ-rays, which were the decay products of π^0-mesons emitted from jets, were estimated at 230 Mev/c (assuming that the P_t distribution of γ-ray resembles that of π^0s, and the average P_t value of π^0 is about twice that of γ). The curve of P_t distribution does not fit the Gaussian form. In the energy region of about 10^{12}ev, the energy spectrum can be fit by single power laws of 1.50 ± 0.42 for ΣE_γ, and 1.60 ± 0.25 for E_γ. There is no correlation between P_t and E_γ. (auth)

19412 LIGHTNING, SOLAR FLARES AND RADIO GALAXIES. Bruce, C. E. R. (Electrical Research Association, Leatherhead, Eng.). Nature, 209: 286(Jan. 15, 1966).

Mechanisms for the production of cosmic electrons are considered. Electric discharges in lightning and solar flares are considered as possible causes of these electrons. Also such high-speed electron components and plasma jets are expected to occur in radio galaxies. (J.F.P.)

19413 LONG TERM MODULATION OF PRIMARY COSMIC RAY INTENSITY. Nagashima, K.; Duggal, S. P.; Pomerantz, M. A. (Franklin Inst., Swarthmore, Pa.). Planet. Space Sci., 14: 177-206(Feb. 1966).

Direct observations of primary cosmic rays are compared with the predictions of alternative theoretical models of the long term intensity modulation. The experimental data used are those of the satellites Explorer VII and Ariel I for heavy primary cosmic rays in the high rigidity region and those of baloons and IMP I for protons and alpha particles in the low rigidity regions. The solar wind and the electric field modulation models are considered in greater detail after it is found that the character of the predictions of the general solar dipole magnetic field theory is similar to that of the solar wind theory in the low rigidity region. A new quantity, ln R, is introduced to characterize the modulation. R is the ratio, j(P or T;t)/j(P or T;t'), between the differential rigidity or energy spectra at two different times. The log-log representation of ln R vs rigidity or kinetic energy/nucleon is advantageous for the comparison of observations with theoretical models and for eliminating the arbitrariness inherent in the conventional representation of the intensity changes. It is found that the most decisive criterion for the comparison is the ratio $\bar{R}(P) = \ln R_p(P) \ln R_\alpha(P)$, where the suffixes denote proton and alpha particles, whereas the quantities $j_p(T,t)/j_\alpha(T,t)$, ln R and $\bar{R}(T)$, etc., cannot serve as a selection criterion if the modulation coefficient, M, for the solar wind model and the energy loss, δE, for the electric field model are rigidity dependent. Because of the dearth of experimental values of $\bar{R}(P)$, a definite conclusion as to whether one of the two models is preferable cannot be reached. However, the present analysis reveals that M and δE, respectively, must be rigidity dependent for the theoretical predictions to fit the experimental results. Thus, for example, the electric field model based on a simple electrostatic potential in the interplanetary space is excluded. Some implications of and restrictions on the two alternative models are discussed. Especially in the case of solar wind modulation theory, many fruitful consequences

can be quantitatively deduced. For example, the analysis reveals that the rigidity dependence of M appeared to differ during the ascending and descending phases of the last solar cycle. The spectrum of M was flatter during 1954–1958 than during 1958–1963, but apparently did not vary drastically during these intervals. The absolute value of M is estimated, in order to compute the unmodulated spectra, and the results indicate that even during the solar minimum period, modulation of the cosmic ray intensity still occurs. (auth)

Direct Energy Conversion

19414 (AE–214) CHARACTERISTICS OF LINEAR MHD GENERATORS WITH ONE OR A FEW LOADS. Witalis, E. A. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Feb. 1966. 16p. (CONF-660704–1). Dep. mn.

For Presentation at Magnetohydrodynamic Electrical Power Generation, 2nd International Symposium, Salzburg.

The theoretical performance of linear series segmented MHD generators with finite size electrodes and one or a few identical external loads is investigated. The electrical characteristics are evaluated as functions of the segmentation degree, the Hall parameter and the relative position of short-circuited electrodes. Special consideration is given to the influence of staggering the electrodes, i.e., shifting the relative positions of short-circuited electrodes. General electrical terminal characteristics, i.e., the full current-voltage relation, can not be obtained by the exact analytical method, which is applicable only to so-called design load conditions or infinitely long MHD channels. However, it is shown how the general properties can be explained qualitatively and calculated approximately by describing off-design modes of operation in terms of a fictitious "effective" number of external loads. (auth)

19415 (N–65–16645) VERGLEICHENDE BETRACHTUNGEN UBER DIE PLASMAERZEUGUNG IN THERMIONISCHEN KONVERTERN. (On Various Methods of Generating Plasma in Thermionic Converters). Schuster K. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Porz (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe). Oct. 1964. 23p. (DLR-FB–64-27; DVL–375). ZLDI, Munich 6,70 DM.

A number of possible methods of generating a plasma in thermionic converters are discussed including surface converters and ionization by low-voltage arcs, photon processes, auxiliary discharges, electron guns, beta particles from Kr, fission fragments, and gamma radiation. (D.C.W.)

19416 (N–65–17881) HIGH-TEMPERATURE, HIGH-CURRENT, ALKALI-METAL VAPOR-FILLED CERAMIC THYRATRONS AND RECTIFIERS. Quarterly Progress Report No. 2. Coolidge, A. W. (General Electric Co., Schenectady, N. Y. Tube Dept.). Jan. 6, 1965. Contract NAS3-6005. 39p. (NASA-CR–54272; GES–23-467). CFSTI $2.00 cy, $0.50 mn.

The reduction of the environmental temperature of the radiator from 600°C to approximately 300°C will permit the study of pure cesium as a filling agent for tubes to be made. The following work on alkali halides was continued: nickel-plated ceramic seal structures were made, a seal structure was made using a palladium–cobalt brazing compound, and seal structures were made using a brazing compound high in nickel and low in titanium content. Effort was also devoted to an evaluation of the inverse current from a molybdenum anode and to an analysis of the effect of work function on spurious emission from an anode or grid. In addition, the test diode was redesigned to increase its inverse voltage ability and to decrease leakage between electrodes. Finally, construction was started on two tubes. These tubes will be filled with thallium and will have barium system cathodes. (STAR)

19417 (N–65–21774) A MAGNETOGASDYNAMIC POWER GENERATION STUDY. Quarterly Progress Report No. 1. Shair, Frederick H. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). Nov. 20, 1964. Contract NAS3-6260. 40p. (NASA-CR–62229). CFSTI $2.00 cy, $0.50 mn.

An expression for the seed concentration which gives rise to the maximum electrical conductivity in a slightly ionized nonequilibrium plasma is derived. Various equilibrium gas systems at the optimum seed mole fraction are compared with pure alkali metal vapors. A typical plot obtained for optimum seed concentrations vs temperature for an argon–cesium plasma is given. During these experiments, the seeding mole varied (probably about some mean value such as the optimum value); the influence of such variations upon the conductivity can be determined from a plot of σ_p vs X_0. It was decided that it is safer to overseed than to underseed because a variation of σ_p due to fluctuations in X when $X < X_0$ is much larger than when $X > X_0$. Calculations were performed to determine the maximum temperature depression due to seeding, noting vaporization, heat of seed gas, ionization, and resonance radiation loss. Preliminary calculations of electron-beam efficiencies indicated the maximum possible power increase as a function of energy imparted to the working fluid from the electron beam. (STAR)

19418 (N–65–22973) APOLLO LOGISTICS SUPPORT SYSTEMS MOLAB STUDIES. RADIOISOTOPE POWER SYSTEMS FOR A LUNAR VEHICLE. Breazeale, W. L. (Northrop Space Labs., Huntsville, Ala.). Mar. 1965. Contract NAS8-11096. 44p. (NASA-CR–61046). CFSTI $2.00 cy, $0.50 mn.

The advantages and feasibility of combining a fuel cell with each of five radioisotope electric power systems are investigated. The five nuclear systems considered are a Brayton cycle system, a Mercury–Rankine cycle system, a Dowtherm–Rankine cycle system, a Stirling engine system, and a thermionic system. The optimized system weight for each fuel cell–nuclear system is calculated for the MOLAB mission, and weight savings of 500 to 1020 lb are realized over an all fuel cell system for the mission. In addition to the MOLAB mission, similar calculations are made for other missions. Also the competitive regions for fuel cells and for nuclear systems are established. Discussions of advantages other than the weight savings afforded by a nuclear–fuel cell system are included. (STAR)

19419 (N–65–24874) ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM. VOLUME II. TECHNICAL BACKGROUND. Final Report. (Electro-Optical Systems, Inc., Pasadena, Calif.). Mar. 10, 1965. Contracts NAS7-100; JPL-950699. 273p. (NASA-CR–62977). CFSTI $6.00 cy, $1.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

An analysis of instrumentation required for operation of the solar-thermionic system and the types of sensors which would be applicable is presented. Considered are those instruments which are needed for control of the system and which are useful for monitoring performance and/or variation of operating conditions by ground command. Discussed are instrumentation required for the generator and concentrator, strain and thermal instrumentation, and reflectance and angular error instrumentation. Three types of temperature sensors were considered for use in system measurements in the range of 0 to 800°C: wire-type resistance sensors, thermocouples, and thermistors. The results show that the wire-type resistance sensors were best suited for the system. Data are also given on methods of measuring emitter temperature, solar flux control, cesium reservoir control, power conditioning and control, configuration and performance data in respect to the power-conditioning equipment for a typical solar-thermionic power system, recommended programs for the development of systems hardware, space environmental effects on reflective surfaces, and the physical properties of mirror substrate materials. (STAR)

19420 (N–65–25271) ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM. VOLUME II. TECHNICAL BACKGROUND, SECTION 1–6. Final Report. Menetrey, W. R.; Neustein, J. (Electro-

Optical Systems, Inc., Pasadena, Calif.). Mar. 10, 1965. Contract NAS7-100. 282p. (NASA-CR-62976). CFSTI $6.00 cy, $1.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Technical background information for the project is presented. Solar concentrators, thermionic cells, thermionic generators, solar flux control, instrumentation, cesium reservoir control, and power conditioning and control are among the topics discussed. (D.C.W.)

19421 (N-65-25406) ANALYSIS OF ANCILLARY EQUIPMENT FOR SOLAR-THERMIONIC SYSTEM. VOLUME I. Final Report. (Electro-Optical Systems, Inc., Pasadena, Calif.). Mar. 10, 1965. Contracts NAS7-100; JPL-950699. 33p. (NASA-CR-63184). CFSTI $2.00 cy, $0.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

The results of an analysis for solar-thermionic systems are summarized; and a series of recommended programs for the development of high-efficiency, reliable, solar-thermionic systems is presented. Weight and efficiency numbers of the system components were based on reasonable projections of the state of the art, and expressions for the concentrator absorber efficiency are shown as a function of cavity temperature and distance from the sun. Beryllium was evaluated as feasible material for generator support. Efficiency curves were derived for converters operating at 15, 20, and 25 w/cm^2 at 0.7 v and emitter temperatures of 1500 to 1800°C. The power and efficiency curves of a five-converter generator were established by testing. All the instruments which are needed for the control and monitoring of the generator were examined for their feasibility, and a block diagram of the recommended power conditioning and control subsystems is presented. Also included is a list of general considerations for the integration of a solar-thermionic system in practical vehicles and missions. (STAR)

19422 (N-65-26628) VAPOR-FILLED THERMIONIC CONVERTERS. Final Report. Hernqvist, K. G.; Fendley, J. R. Jr.; Levine, J. D. (RCA Labs., Radio Corp. of America, Princeton, N. J.). Apr. 1965. Contract NAS3-4173. 48p. (NASA-CR-54421). CFSTI $2.00 cy, $0.50 mn.

Theoretical studies that are necessary for interpreting experimental conductivity data of cesium on insulators were completed. Starting from the Schrödinger equation for a single adsorbed cesium atom, wave functions, and their properties were compiled. This information and Kopineck's integrals are used to compute the tunneling (resonance) energy between two adsorbed cesium atoms, which is then generalized to an entire array of adsorbed cesium atoms. One of the most important consequences of the theory is that, to a first approximation, conductivity should be proportional to the square of the cesium pressure. The experimental data verify this and also verify other anticipated dependencies on dielectric constant and surface contamination. The cesium adsorption heat on clean alumina and Pyrex surfaces is calculated to be 0.85 ev; and the large configurational entropy term, $\Delta s/k \approx 6$, seems to indicate a long-range order in agreement with certain low-energy electron diffraction studies. Data obtained under contaminated conditions have shown that adsorbed hydrogen causes the conductivity to increase following a $^2/_3$-power law, while leaving the cesium adsorption heat invariant. Various measurements of arc drop and anode work function are reported. Arc drop is found to be nearly 0.5 v for cathode temperature in the range 1300 to 1500°K and current density of 6 to 12 amp/cm^2. Anode work function with a high cesium coverage has been found to be equal to or greater than 1.93 v. A method is described for measuring the work function of metal surfaces coated with adsorbed cesium or with a combination of cesium and oxygen. An analysis of the effects of reverse currents in thermionic converters is presented. It is shown that reverse currents cause a contribution to the arc drop and also impose limiting conditions on the useful range of anode work functions. (STAR)

19423 (N-65-27044) UBERBLICK UBER DEN STAND DER UNTERSUCHUNGEN UND MOGLICHKEITEN DER ANWENDUNG QUASISTATIONARER ELEKTRODENLOSER MHD-SYSTEME. (Review on Possible Applications of Electrodeless MHD Systems). Peschka, W. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Porz (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe). Aug. 1964. 34p. (DVL-315; DLR-FB-64-14). ZLDI, Munich 9,20 DM.

The use of electrodeless MHD generators in space power systems is briefly discussed. The principles of these generators are outlined, and the importance of using superconducting materials is noted. (D.C.W.)

19424 (NASA-TN-D-3345) GENERATOR WITH A SUPERCONDUCTING MAGNETIC FIELD FOR USE IN 1-MEGAWATT SPACE POWER SYSTEMS. Cooper, Dale W.; Kuhns, Perry W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1966. 51p. CFSTI $0.75 cy, $0.50 mn.

A space turboelectric generation system delivering 5000 volts, direct current, at a 1-megawatt power level is analyzed. This system employs a superconducting field as the stator with a 200 or 340°K rotor as the armature. Both alternating- and direct-current models of this generator are studied for possible spacecraft use. A comparison with other rotating generation systems that might be used as alternatives shows that the superconducting magnet generator system holds promise of being lighter in weight and more efficient. Consideration is given to the effects of refrigeration system weight and to the seal, bearing, and electric-contact problems in space. A parametric analysis of various rotating generator types is also made. (auth)

19425 INVESTIGATION OF THE VOLT-AMPERE CHARACTERISTICS OF THERMIONIC CONVERTERS. Dyuzhev, G. A.; Martsinovskii, A. M.; Pikus, G. E.; Tsirkel', B. I.; Yur'ev, V. G. Zh. Tekh. Fiz., 35: 1054-64 (1965). (In Russian).

The volt-ampere characteristics of cesium-filled thermionic energy converters were examined both in the diffusion and arc modes of operation. Plane-parallel diodes with interelectrode spacings of 0.02–2 mm and electrode surfaces of 0.3–0.8 cm^2 were used in all the experiments. At the diffusion mode, the characteristics agreed with theoretical data (B. Ya. Moyzhes and G. Ye. Pikus, FTT, 2, 4, 756, 1960). At high temperatures, the transition to the arc mode took place smoothly, which is explained by the presence of an accelerating field at the emitter. The fact that even the smallest arc current was close to the emission current was also attributed to this accelerating field. The absence of saturation in the volt-ampere characteristics was thought to be connected with the anomalous Schottky effect arising as the result of the cathode barrier. (ATD)

Elementary Particles and Radiations

See also Field Theory, Scattering Theory, and Symmetries

Refer also to abstracts 18546, 19411, 19572, 19981, 19982, 19994, and 20303.

19426 (ANL-7130) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON WEAK INTERACTIONS, OCTOBER 25-27, 1965. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 443p. (CONF-651043). Dep. mn. CFSTI $4.75 cy, $2.00 mn.

Separate abstracts are prepared for 20 of the 30 included papers. For papers from this conference previously abstracted in NSA see the Report Number Index under CONF-651043. (M.O.W.)

For abstracts of individual papers see: 19408, 19409, 19427–19440, 19532, and 19806–19808.

19427 (ANL-7130, pp 13-16) TIME REVERSAL INVARIANCE IN $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$. Glasser, R. G.; Kehoe, B. (Maryland Univ., College Park); Engelmann, P.; Schneider, H. (Heidelberg Univ. (West Germany); Alff, C.; Kirsh, Larry L. (Columbia Univ., New York).

An experiment is suggested for investigating the time reversal invariance of the electromagnetic interaction by studying the polarization of Λ in the Dalitz decay of the Σ hyperon: $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$. (M.O.W.)

19428 (ANL–7130, pp 17-28) EXPERIMENTAL STATUS OF C. P. VIOLATION. Cronin, James W. (Princeton Univ., N. J. Palmer Physical Lab.).

A brief survey of CP noninvariance experiments was made in an attempt to make a systematic analysis required to characterize in a phenomenological way the CP violating effect in $K_2^0 \rightarrow \pi^+\pi^-$. (M.O.W.)

19429 (ANL–7130, pp 59-66) MEASUREMENT OF THE RATE OF K_2^0 DECAY INTO THREE PIONS AND TEST OF CP INVARIANCE. Behr, L.; Brisson, V.; Petiau, P.; (and others) (Ecole Polytechnique, Paris (France)).

The three pion decay modes of the K_2^0 were investigated for the determination of the absolute rates $\Gamma_2(+-0)$ and $\Gamma_2(000)$. The experiment was performed with a K^+ beam from the CERN PS in the Ecole Polytechnique Heavy Liquid Bubble Chamber. The decay rates are given by $\Gamma_2(+-0) = N(\pi^+\pi^-\pi^0)/T$ and $\Gamma_2(000) = N(\pi^0\pi^0\pi^0)/T$ where $N(3\pi)$ is the number of observed events corrected for detection and scanning efficiency and T is the total observable time of flight of all K_2^0's inside the fiducial volume taking into account the attenuation of the K_2^0 flux by decay and interaction. A test for CP invariance is briefly discussed. (M.O.W.)

19430 (ANL–7130, pp 67-75) THE DECAY $K_2^0 \rightarrow \pi^+\pi^-\pi^0$. Hopkins, H. W. K.; Bacon, T. C. (Vanderbilt Univ., Nashville, Tenn.); Eisler, F. R. (Rutgers Univ., New Brunswick, N. J.).

The experimental results of a study of the decay $K_2^0 \rightarrow \pi^+\pi^-\pi^0$ are presented. A discussion of the results is included. (M.O.W.)

19431 (ANL–7130, pp 77-81) PRELIMINARY RESULTS ON THE CHARGED DECAY MODES OF K_2^0. Basile, P.; Bingert, J.; Cronin, J. W.; Thevenet, B.; Turlay, R.; Zylberach, S.; Zylberstejn, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The decay modes $\pi e\nu$, $\pi\mu\nu$, $\pi^+\pi^-\pi^0$, and $\pi^+\pi^-$ of K_2^0 were investigated. The preliminary experimental results are presented. (M.O.W.)

19432 (ANL–7130, pp 83-90) THE ENERGY DEPENDENCE OF THE VECTOR FORM FACTOR IN THE $K_{\epsilon 3}^0$ DECAY. Fisher, G. P.; Abashian, A.; Abrams, R. J.; Carpenter, D. W.; Nefkens, B. M. K.; Smith, J. H.; Wattenberg, A. (Illinois Univ., Urbana. Dept. of Physics).

The experimental results on $K_{\epsilon 3}^0$ decays are presented. In particular, the decay $K_{\epsilon 3}^0 \rightarrow \pi^+ + e^+ + \nu$ was investigated to study the energy dependence of the vector form factor of the weak interactions. The results are discussed. (M.O.W.)

19433 (ANL–7130, pp 91-105) SPARK CHAMBER MEASUREMENT OF THE $K_{\mu 3}^0$ DECAY SPECTRUM. Carpenter, D. W.; Abashian, A.; Abrams, R. J.; Fisher, G. P.; Nefkens, B. M. K.; Smith, J. H. (Illinois Univ., Urbana. Dept. of Physics).

The experimental technique for obtaining the $K_{\mu 3}^0$ decay spectra using a spark chamber is outlined. A fit of the data to constant form factors, J = 1 intermediate state, and linearly varying form factors is discussed. Charge asymmetry and neutral currents are discussed. (M.O.W.)

19434 (ANL–7130, pp 107-13) $K_{\epsilon 2}^+$ BRANCHING RATIO. Bowen, D. R.; Mann, A. K.; McFarlane, W. K. (Pennsylvania Univ., Philadelphia); Franklin, A. D.; Hughes, E. B.; Imlay, R. L.; O'Neill, G. K.; Reading, D. H. (Princeton Univ., N. J.).

An attempt was made to detect the $K^+ \rightarrow e^+ + \nu$ ($K_{\epsilon 2}^+$) decay mode using spark chamber and counter techniques. The pure leptonic decays of the charged π and K mesons provide stringent tests of the (V-A) theory of weak interactions. Thus the agreement between the predicted ratio of rates for the decays $\pi^+ \rightarrow e^+ + \nu$ and $\pi^+ \rightarrow \mu^+ + \nu$ and the observed ratio was investigated. (M.O.W.)

19435 (ANL–7130, pp 153-7) TIME DISTRIBUTION OF K^0 LEPTONIC DECAYS. Aubert, B.; Behr, L.; Chounet, L. M.; Lowys, J. P.; Pascaud, C. (Ecole Polytechnique, Orsay (France). Faculte des Science Accelerateur Lineaire).

The time distribution of 315 $K^0 \rightarrow \pi\ e\nu$ was studied in the Ecole Polytechnique heavy liquid bubble chamber. Only electronic decays where the electron was directly recognized (stopping in the chamber) were used. This experiment measures the number of events N^+ (t) $K^0 \rightarrow \pi^- e^+ \nu$ and N^- (t) $K^0 \rightarrow \pi^+ e^- \nu$, as a function of time. These distributions provide a test of $\Delta S = \Delta Q$ selection rule. If one observes a violation of this rule, then one is able to test PC conservation in electronic K^0 decays. The results are discussed. (M.O.W.)

19436 (ANL–7130, pp 159-88) SELECTION RULES IN LEPTONIC DECAY. Willis, W. J. (Yale Univ., New Haven, Conn.).

The experimental status of a number of proposed selection rules in leptonic decays is reviewed. In particular, neutral leptonic currents, $\Delta S = \Delta Q$, $|\Delta S| < 2$, second class currents, and octet currents are discussed. The K_{e4} decays are discussed. (M.O.W.)

19437 (ANL–7130, pp 215-30) K_1–K_2 MASS DIFFERENCE AND K_1^0 REGENERATION. Good, Myron L. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette (France)).

The experimental situation regarding the magnitude and sign of the $K_1 - K_2$ mass difference is reviewed. $K_1 - K_2$ regeneration experiments are discussed from the viewpoint of attempting to learn from them as much as one can about the weak interactions. In particular, CPT tests are discussed. (M.O.W.)

19438 (ANL–7130, pp 257-71) ν AND $\bar{\nu}$ INTERACTIONS IN A HEAVY LIQUID BUBBLE CHAMBER. Cundy, D. C. (European Organization for Nuclear Research, Geneva (Switzerland)).

The CERN ν and $\bar{\nu}$ experiments and preliminary results are briefly discussed with respect to phenomenological account of $\bar{\nu}$ – run, the elastic process; $\nu + n \rightarrow \mu^- + p$ and $\bar{\nu} + p \rightarrow \mu^+ + n$, and a comparison of the single pion events with the $N_{33}(1238)$ production model. (M.O.W.)

19439 (ANL–7130, pp 273-84) HIGH ENERGY NEUTRINO EXPERIMENTS AT ACCELERATORS. Perkins, D. H. (Oxford Univ. (England)).

Some of the problems of weak interaction physics which one might hope neutrino experiments to answer, and the improvements in experimental conditions needed to answer them, are discussed using the situation at CERN/BNL 1963/64 as a basis. The state of the existing experimental data is discussed only briefly. Finally, a brief description is given of the programs of beam improvement, machine development and giant chambers which are needed to obtain the necessary increase in event rate. (M.O.W.)

19440 (ANL–7130, pp 337-71) WEAK INTERACTIONS OF NON-STRANGE PARTICLES. Telegdi, V. L. (Chicago Univ., Ill.).

The CVC theory is briefly discussed in terms of obtaining the value of G_V^β, weak magnetism, and forbidden Fermi transitions. The ratio $G_A^\beta/G_V^\beta \equiv \psi$ is discussed in terms of weak parity violating forces between nucleons. A few experiments are outlined. The application of elementary particle concepts to the β decay of complex nuclei is reviewed. Muon decay is briefly discussed. (M.O.W.)

19441 (JINR–E-2560) MEASUREMENT OF THE PARAMETER R IN THE ELASTIC pn- SCATTERING AT 605 Mev AND THE NUCLEON-NUCLEON PHASE SHIFT ANALYSIS. Janout, Z.; Kazarinov, Yu. M.; Lehar, F.; Pisarev, A. F.; Simonov, Yu. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1966. 20p. Dep. mn.

The triple scattering parameter and the polarization in p-n scattering at 605 Mev were measured using spark

chambers. Measurements were made at 90 and 125°. (D.C.W.)

19442 (JINR–E-2609) UNAMBIGUOUS PHASE-SHIFT ANALYSIS OF THE NUCLEON-NUCLEON SCATTERING AT 23.1 Mev. Bilenkaya, S. I.; Janout, Z.; Kazarinov, Yu. M.; Lehar, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1966. 18p. Dep. mn.

The phase shift analysis of NN scattering was carried out with account of new data on polarization correlation in (n-p) and (p-p) collisions and of the element of the asymmetry tensor a_{ss} at 23.1 Mev. The unique solution with negative mixing parameter was found to be $\epsilon_1 = -4.86 \pm 1.39$ for $l_{max} = 2$. The phase shifts are given for $l_{max} = 2$ and $l_{max} = 3$ as well as the plots of the experimentally measurable quantities a_{ss} for (p-p) and (n-p) scatterings. (auth)

19443 (JINR–E-2614) A POSSIBLE DIRECT TEST OF CP VIOLATION IN THE K_2^0 INTERACTIONS. Arbuzov, B. A.; Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 7p. Dep. mn.

Experiments are proposed to test the CP violation in a direct way. The processes $K_2^0 \rightarrow \pi^0 e^+ e^-$ and $K_2^0 \rightarrow z \rightarrow \pi^0(\gamma\gamma^0) + z$, which are forbidden in the one-photon exchange approximation by CP invariance, are considered. The estimates are given for the probabilities of these processes on the basis of the CP violating mechanism which was proposed earlier. (auth)

19444 (LYCEN–6537) CONTRIBUTION A L'ETUDE DE LA DIFFUSION ELASTIQUE PION-NUCLEON LIE [Theses]. (Contribution to the Study of Bound Pion-Nucleon Elastic Scattering [Thesis]). Bastard, Claude (Lyon Univ. (France). Institut de Physique Nucleaire). Dec. 15, 1965. 94p. Dep. mn.

The elastic scattering of pions by bound nucleons at high energies was studied experimentally and theoretically. It was established experimentally that for large scattering angles, the differential cross sections for scattering by bound protons and free protons are almost equal. (D.C.W.)

19445 (NEIC-RR–20) THE BIBLIOGRAPHY OF THE NEUTRINO. PART I. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1966. 214p. Dep.

This bibliography contains all papers related to the neutrino problem which were published up to autumn 1965. (M.O.W.)

19446 (NP–15932) NEUTRINOS IN SUPERDENSE MATTER. III. ON PARTIALLY EXTERNAL TRAJECTORIES. Kuchowicz, Bronislaw (Warsaw Univ. (Poland). Dept. of Radiochemistry). Jan. 1966. 20p. Dep.

It was previously shown that for certain values of parameters the neutrinos can move in a stationary way inside an incompressible fluid sphere. It is shown now that for another interval of parameters the neutrinos may cross the boundary of the sphere. The highest value of the distance from the center at which neutrinos may be found on a stationary non-hyperbolic trajectory is equal to $4/3\ r_1$, where r_1 is the geometrical radius of the sphere. (auth)

19447 (UCRL–14614-T) THE NON-DYNAMICAL STRUCTURE OF PHOTOPRODUCTION PROCESSES. Csonka, Paul L.; Moravcsik, Michael J.; Scadron, Michael D. (Lawrence Radiation Lab., Univ. of California, Livermore). Jan. 1966. Contract W-7405-eng-48. 68p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Those general properties of photoproduction processes which are independent of the interactions among particles are summarized. The two types of interactions considered in detail are $\gamma + 1/2 \rightarrow s + 1/2$ and $\gamma + 1/2 \rightarrow s + 3/2$, where $1/2$ and $3/2$ denote particles with spins $1/2$ and $3/2$, respectively, and s denotes a particle with an arbitrary integer spin s. The first of these interactions is synthesized from the interactions $\gamma + 0 \rightarrow 0 + 0$, $0 + 1/2 \rightarrow 0 + 1/2$, and $0 + 0 \rightarrow s + 0$. First, the observable structure of these constituent interactions is derived, and then the composite structure is obtained. Detailed results for the observables are given for s = 0, 1, and 2, and experiments designed to determine spin and parity are listed. The interaction $\gamma + 1/2 \rightarrow s + 3/2$ is similarly composed of $\gamma + 0 \rightarrow 0 + 0$, $0 + 1/2 \rightarrow 0 + 3/2$, and $0 + 0 \rightarrow s + 0$. Some results for this interaction are also tabulated. Finally, as a specific application of the above results, a method is proposed for determining the contribution of certain corrections to the static theory of pion photoproduction from nucleons. (auth)

19448 (UCRL–16462) MESONS. Rosenfeld, A. H. (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 1965. Contract W-7405-eng-48. 112p. (CONF-650945–5). Dep. mn. CFSTI $4.00 cy, $0.75 mn.

From International Conference on Elementary Particles, Oxford.

The entire list of certified plus uncertified resonances is discussed. Discussions are presented concerning the following: resonances vs other effects, acceptance criteria, quantum numbers G, C, and A, singlets, triplets, doublets, (all discussed in order of increasing mass), the 2^+ nonet, three nonets and the leftovers, and K_χ^* and K^+K^+ mesons. (M.O.W.)

19449 (UR-875-123 and (Add.)) PRODUCTION OF A_1, A_2, AND B MESONS IN HIGH-ENERGY $\pi^\pm p$ INTERACTIONS. Ferbel, Thomas (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Feb. 15, 1966. Contract AT(30-1)-875. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Data available on the two reactions $\pi^\pm + p \rightarrow \pi^\pm + p + \pi^\pm + \pi^-$ and $\pi^\pm + p \rightarrow \pi^\pm + p + \pi^+ + \pi^- + \pi^0$ were collected for incoming pion momenta in excess of 2.5 Bev/c in order to have sufficiently good statistics to observe A_1, A_2, and B meson production. Results from this analysis are presented. (M.O.W.)

19450 (UR–875-126) CONTRIBUTIONS TO THE WILLIAMSBURG CONFERENCE ON INTERMEDIATE-ENERGY PHYSICS. Burman, R. L.; Kinsey, K. F.; Koehler, P. F. M. (and others) (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Feb. 25, 1966. Contract AT(30-1)-875. 70p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Separate abstracts are prepared for the five included papers. (M.O.W.)

For abstracts of individual papers see: 19451–19453, 19842, and 19843.

19451 (UR–875-126, Paper 3) A MEASUREMENT OF THE LIFETIME OF THE POSITIVE PION. Kinsey, K. F.; Lobkowicz, L.; Nordberg, M. E. Jr. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 11p.

The decay of about 10^8 positive pions was measured. Diagrams are given showing the counter array and electronic apparatus used in the measurement. The mean of the best values obtained was 26.41 sec. (M.O.W.)

19452 (UR–875-126, Paper 4) NUCLEON-NUCLEON BREMSSTRAHLUNG AT 200 Mev. Rothe, K. W.; Koehler, P. F. M.; Thorndike, E. H. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 18p.

An incident beam of 204-Mev protons strikes a 3″ hydrogen target; the resulting γ-ray is detected in coincidence with two protons. The γ production cross sections are presented along with other pertinent reaction kinematics. (M.O.W.)

19453 (UR–875-126, Paper 5) NEUTRON-PROTON INTERACTIONS AT 205 Mev. Thorndike, E. H.; Reay, N. W.; Spalding, D.; Thomas, A. R. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 12p.

The neutron-proton interaction was investigated by bombarding deuterons with 205-Mev polarized protons, and observing high energy neutrons recoiling into forward angles. The parameters P and R_t were measured. The polarization parameter P was obtained by measuring the up-down asymmetry of the recoiling neutrons. The neutrons were detected in a counter consisting of a polyethylene converter and a multi-element range telescope.

Measurements were made at neutron laboratory angles between 10 and 30°. Statistical errors were typically ±0.017. Measurements of R_t were made at angles between 0 and 20°, to an accuracy of typically ±0.09. (M.O.W.)

19454 (YALE-1807-33) NUCLEON-NUCLEON SCATTERING. Breit, G. (Yale Univ., New Haven, Conn.). Feb. 9, 1966. Contract AT(30-1)-1807. 24p. (CONF-660209-1). Dep. mn, CFSTI $2.00 cy, $0.50 mn.

From Conference on Intermediate Energy Physics, Williamsburg, Va.

The discussion is confined to energies at which meson production has a negligible effect. Scattering can then be described by means of real phase shifts and coupling parameters. Various aspects of nucleon-nucleon interactions are discussed, and a review of corresponding data is presented. (M.O.W.)

19455 CHERENKOV RADIATION, PHYSICAL AND UNPHYSICAL, AND ITS RELATION TO RADIATION FROM AN ACCELERATED ELECTRON. Lawson, J. D. (Rutherford High Energy Lab., Chilton, Eng.). Amer. J. Phys., 33: 1002-5(Dec. 1965).

The δ-function of current that represents an electron traveling in a straight line is Fourier analyzed into a spectrum of infinite linear harmonic currents, having spectral distributions both in frequency and phase velocity. The radiation (and induction) fields associated with these currents are associated either with Cherenkov radiation or with acceleration or deceleration radiation ("bremsstrahlung" in the literal sense) according to whether the velocity of the electron exceeds or is less than that of light in the medium. The analysis of the two situations is identical; indeed, the two types of radiation cannot, in general, be sharply distinguished. (auth)

19456 SYNCHROTRON RADIATION FROM A DIPOLE FIELD. Ortwein, N. R. (Navy Electronics Lab., San Diego, Calif.); Chang, D. B.; Davis, Leverett Jr. Astrophys. J. Suppl. Ser., 12: Suppl. No. 111, 323-90(Feb. 1966).

Tables of two-dimensional distribution of Stokes parameters for synchrotron radiation from ultra-relativistic electrons in a dipole field are compiled for various energy and spatial distributions, and for varying angles between the dipole axis and the line of sight. (auth)

19457 ON A GENERALIZATION OF CHEW'S RECIPROCAL BOOTSTRAP BETWEEN N AND Δ. Majewski, W. Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 13: 737-43(1965)

An extension of Chew's self-consistent model for N and Δ (1238) baryons is attempted. In this approach the mechanism of generation of the mesons is not taken into account because they are taken "from outside" as input information. According to the general idea of the bootstrap procedure, it is expected that this extended self-consistent calculation will give the parameters of particles taken into account in the first version of the model closer to the experimental values, and also some new parameters connected with the inclusion of a new particle may be obtained. The reciprocal generation of N and Δ in two coupled p wave scattering channels, $\pi - N$ and $\pi - \Delta$, is considered by means of the effective range static approximation. (J.F.P.)

19458 RADIATION OF SUPER-PHASE VELOCITY. Sun, Lap-Ting (Chinese Univ., Hong Kong); Young, Kiang-Chuen. Chin. J. Phys. (Taiwan), 3: 123-6(Oct. 1965).

A classical treatment of the radiation of super-phase velocity of scalar and vector fields is presented with a hope that it could be extended to the case of multiple meson production in a nucleus by nucleons of a very high energy. (auth)

19459 BETA RADIOACTIVITY AND WEAK INTERACTIONS. Nataf, R. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). pp 421-39 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964. (In French).

A review is given on the theory of weak interactions. The current-current hypothesis, the universal Fermi interaction, and the conserved vector current are discussed. The octet structure in SU(3) of strong currents is considered. Experiments on beta decay and meson (μ) capture are summarized. (C.E.S.)

19460 POSITRONIUM FORMATION AND REACTIONS. Green, J. H. (Univ. of New South Wales, Sydney). Endeavour, 25: 16-20(Jan. 1966).

Positronium—the relatively stable combination of a positron and an electron—was first shown to exist some fourteen years ago. More recent work shows that it can take part in a number of reactions with solids, liquids, and gases. The formation of positronium and the nature of these reactions, and their use as a method of determining the structure of solids is discussed. (auth)

19461 ON THE PHENOMENOLOGICAL DESCRIPTION OF CP VIOLATION FOR K-MESONS AND ITS CONSEQUENCES. Enz, C. P.; Lewis, R. R. (Univ., Geneva). Helv. Phys. Acta, 38: 860-76(1965).

Recently, a violation of CP was shown by the discovery of the $\pi^+ + \pi^-$ mode of decay of the long-lived K mesons. This case of CP violation in the $K^0 - \overline{K}^0$ system is described phenomenologically by two complex parameters, one measuring the nonconservation of T, the other, the nonconservation of CPT in the energy matrix. These parameters are discussed in detail, and the experimental possibilities of determining them are examined. Proposals for experiments are made in the following areas: (i) strong interactions (measurement of the phase of intensity oscillation), (ii) decays (comparison of the oscillation in the decay counts for an initial K^0 and an initial $\overline{K}^0$), (iii) coherent regeneration in matter (measurement of the decay counts as a function of the density), and (iv) production of $K - \overline{K}$ pairs (detection of decays or reactions originating from initial $K - \overline{K}$ pairs with even angular momentum, produced, for instance, by resonances). (tr-auth)

19462 CYCLOTRON RESONANCE INTERACTION OF MICROWAVES WITH ENERGETIC ELECTRONS. Hirshfield, J. L.; Bernstein, I. B.; Wachtel, J. M. (Yale Univ., New Haven). IEEE (Inst. Elec. Electron. Eng.), J. Quantum Electron, QE-1: 237-45(Sept. 1965).

A detailed examination is made of the interaction of energetic free electrons with bounded electromagnetic waves near cyclotron resonance. Recent development of a fast-wave oscillator, the electron cyclotron maser, has shown that earlier descriptions of configurations need to be generalized to properly and unambiguously describe the features of such an interaction. Need for such a detailed study was given recent impetus by the construction of an oscillator at 2-mm wavelength, giving watt-level outputs. The basic gain mechanism in the cyclotron maser can be understood in either quantum mechanical or classical terms; here, the quantum description is reviewed, with reference to classical physics for detailed results. Following introductory material, the original experimental results are reviewed. Then, to draw the proper comparison between this interaction and those involving either synchronous bunching due to r-f magnetic forces or gain due to transit-time effects, a detailed analysis is given. An account of linearized behavior is followed by a description of the nonlinear saturation of the device which is developed. This discussion leads to speculation as to the properties of the oscillator as it is scaled to millimeter wavelengths. (BBB)

19463 INELASTIC NEUTRINO-ELECTRON INTERACTIONS. Kerimov, B. K.; Romanov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1172-6(July 1965). (In Russian).

The two schemes for describing weak interactions involving leptons—one in which the massless neutrino has two components and muon number is conserved and the other in which the massless neutrino is described by a four-component Dirac spinor—are summarized, and their correlation with the Feynman-Gell-Mann formalism and the assignment of left- and right-handed polarizations to the neutrinos are discussed. Interactions of neutrinos

(antineutrinos) with electrons and positrons leading to the formation of muons are studied. The differential and total cross sections for inelastic neutrino-electron scattering are obtained, and the various channels of these interactions allowed by the two- and four-component theories of the neutrino are analyzed. (M.J.T.)

19464 ON THE PROBLEM OF NEUTRINO SCATTERING ON ELECTRONS. Romanov, Yu. I. (Inst. of Medical Radiology, Academy of Medical Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1248-52(July 1965). (In Russian).

The polarized states of the recoil electrons in ν-e and $\bar{\nu}$-e scattering and the role of the symmetric neutral lepton currents in these processes are investigated. Neutrino scattering on a bound electron is also considered. The calculations are carried out in the framework of the four-component theory of the neutrino. (M.J.T.)

19465 SOME CHARACTERISTICS OF NUCLEAR INTERACTIONS PRODUCED BY 725-Mev/c ANTI-PROTONS IN NUCLEAR EMULSIONS. Ahmed, Mushtaq; Sharif, Mohammed; Haque, M. Bazlul (Univ., Dacca, Pakistan). J. Natur. Sci. Math., 5: 143-58(Oct. 1965).

Nuclear interactions produced by antiprotons of momentum 725 Mev/c in nuclear emulsions were analyzed to deduce informations regarding some of the characteristics of antiproton–nucleon interactions. A total of 1156 antiproton capture at rest and in flight, with kinetic energies within the range of 0 to 250 Mev, were obtained by area scanning. Accurate measurements of multiple scattering and of grain density were made on a number of favorable tracks of relativistic secondary particles; 26 shower particles were identified. The mean number of shower particles, $\bar{n}_s$, and of heavy particles, $\bar{N}_h$, per interaction are found to be 0.91 ± 0.03 and 4.86 ± 0.07, respectively. Curves were plotted for N_h-distributions, and also for N_g-distributions, corresponding to one-, two-, three-, and four-minima and these more or less exhibit the same trends of variations. Curves were also plotted for $\bar{N}_h$ vs. n_s and for $\bar{n}_s$ vs. N_h. (auth)

19466 PROTON-PROTON COLLISION WITH DEUTERON PRODUCTION IN PERIPHERAL MODEL. Dhar, S. D.; Choudhury, A. L.; Rafiqullah, A. K.; Husain, D. (Univ., Dacca, Pakistan). J. Natur. Sci. Math., 5: 173-80 (Oct. 1965).

Proton-proton collisions were studied for the particular reaction $p + p \rightarrow d + \pi^+$ in one-pion exchange model. The differential cross-section is obtained for the outgoing deuteron in the c.m. system. Only one Feynman graph taking into effect one partial wave and one resonant state of the pion nucleon system is considered to see the extent of reproduction of the experimental spectrum in the energy interval 2.2 to 3.4 Bev in the c.m. system. (auth)

19467 DECAY CHARACTERISTICS OF CHARGED Σ HYPERONS. Husain, A.; Basak, A. K.; Rahman, M.; Huq, S. S. (Univ., Rajshahi, Pakistan). J. Natur. Sci. Math., 5: 191-201(Oct. 1965).

A systematic study was made on 731 K^- stars in a stack of emulsion plates exposed to 500 Mev/c negative K mesons from the Bevatron at the Lawrence Radiation Laboratory. In 102 cases Σ hyperons were found to be emitted and 42 of which were found to decay. There were 11 protonic and 13 pionic decays at rest, 5 protonic and 12 pionic decays in flight and one unique case of photonic decay event. This along with previous work, leads to the probability $2/125 = (1.6 \pm 0.19)\%$ of photonic decay mode. From the up-down asymmetry in the distribution of the decay pion, the values of the non-conserving parameter α's are found to be $\alpha^0\bar{P} = -0.25 \pm 0.65$, $\alpha^+\bar{P} = 0.15 \pm 0.73$ and $\alpha^-\bar{P} = -0.17 \pm 0.76$ where superscripts refer to the charges of the decay pion and $\bar{P}$, the average polarisation of Σ hyperon. For the forward-backward distribution, 25 events were found to be in the backward hemisphere out of a total of 41 events. This with previous work yields 46 events found to be in the backward hemisphere out of a tally of 81 events, which shows a substantial asymmetry in the forward-backward distributions, thus favoring the hypothesis of the parity doublet states of Σ hyperon. The angular distribution curve of decay pion shows its fair fitting with the theoretical isotropic as well as $(1 + 3\cos^2\theta)$ distribution. This supports the idea that the spin of Σ hyperon might be in between $\frac{1}{2}$ and $\frac{3}{2}$, i.e., it might have integral spin. (auth)

19468 QUASI PARTICLES IN MULTIPARTICLE SYSTEMS. Hugenholtz, N. M. (RU, afd. Theoretische Natuurkunde, Groningen, Netherlands). Ned. Tijdschr. Natuur., 31: 381-401(Nov. 1965). (In Dutch).

The properties and characteristics of fermion, electron, and boson gases are reviewed. The ground state, one-particle excitation, and collective excitation are described for the fermion gas. Phonons and rotons and the Bogoliubov model are considered for the bosons. Broken symmetry and boson excitation are discussed in conclusion. (J.S.R.)

19469 PERIPHERAL MODEL STUDY OF Y_1^* IN π^--p COLLISIONS. Agarwal, B. K.; Gupta, Y. M. (Univ. of Allahabad, India). Nucl. Phys., 79: 640-4(1966).

The one-particle exchange model was applied to study the formation and decay of Y_1^* in π^--p collisions. The calculated results are in agreement with the available experimental data. (auth)

19470 NEW SUM RULES FOR THE REAL PART OF THE FORWARD SCATTERING AMPLITUDE. Wit, Romuald (Jagellonian Univ., Krakow). Nucl. Phys., 79: 664-72(1966).

A more appropriate form of the new sum rule for the part of the $\pi^\pm$–p (symmetrized) forward scattering amplitude is derived, in which the unphysical region of integration is removed. It is shown that the new sum rules constitute a straightforward generalization of the argument principle. Some applications of the obtained results are discussed. (auth)

19471 CALCULATION OF THE MASS AND WIDTH OF Y*. Castoldi, P. (Univ. Libre, Brussels). Nucl. Phys., 79: 673-90(1966).

A self-consistent calculation of the mass and coupling constants of the Y* (1385 Mev) was performed. The $(\pi\Lambda)$, $(\pi\Sigma)$, $(\bar{K}N)$ coupled channels are taken into account. Writing the amplitude matrix in the form ND^{-1}, approximate calculations are given of the $N_{ij}(s)$ functions which are represented as pole terms; they depend on the parameters of the Y*. A self-consistent technique is employed; the calculated mass and decay widths are $m(Y^*) \approx 1365$ Mev, $\Gamma(Y^* \rightarrow \pi\Lambda) \approx 40$ Mev; $\Gamma(Y^* \rightarrow \pi\Sigma) \approx 3$ Mev. (auth)

19472 ON THE EFFECTIVE MASS DISTRIBUTION OF DIFFRACTION DISSOCIATION PROCESSES. Nagy, E. (Central Research Inst. of Physics, Budapest). Nucl. Phys., 79: 691-4(1966).

The effective mass distribution of secondary particles is calculated for diffraction dissociation processes using the model suggested by Good and Walker. As an application the mass distribution expected for the reaction $\pi^- + N \rightarrow \pi^- + \pi^+ + \pi^- + N$ in emulsion at 17.2 Bev is plotted. (auth)

19473 POLARIZATION IN HIGH-ENERGY PION-PROTON SCATTERING. Dosch, H. G. (Univ., Heidelberg); Fridman, A. Nuovo Cimento (10), 42A: 1-8(1966).

The polarization of the recoil protons in $\pi^\pm$p scattering above 2.9 Bev/c incident pion momentum was calculated. Under the assumption of a spin-independent diffraction and a OBE contribution one obtains a rather big polarization, which is positive for π^+p and negative for π^-p scattering. (auth)

19474 ANALYSIS OF CP VIOLATION IN POSSIBLE EXPERIMENTS ON K^0 DECAY. Wolfenstein, L. (CERN, Geneva). Nuovo Cimento (10), 42A: 17-38(1966).

The phenomenological analysis of CP violation in $K^0 \rightarrow 2\pi$ is reviewed in order to relate the information obtainable to various classes of hamiltonian models. In particular, it is shown that two additional experiments beyond the rate of

$K_L^0 \rightarrow \pi^+ + \pi^-$ are necessary to determine one new CP-violating parameter, which is proportional to the $\Delta I = 1/2$ violating amplitude. While a nonzero value of this parameter would rule out several classes of models, a zero value would rule out none. A test of CPT invariance from $K^0 \rightarrow 2\pi$ decays is presented. The analysis is extended to the charge asymmetry in the leptonic decays of K_L^0. (auth)

19475 EFFECT OF HARD CORE ON THE Λ-p SCATTERING CROSS SECTION. Abou-Hadid, L. F.; El-Raey, M. (Tarik El-Horria, Alexandria, Egypt). Nuovo Cimento (10), 42A: 67-76(1966).

Using a hard-core Yukawa potential, the Λ-p scattering cross-section is obtained by the Born approximation method in the energy range (40–250) Mev. Agreement with experimental data is fairly good. The potential used was successful in obtaining the binding energy of the hypertriton. The effect of the existence of a repulsive core is also discussed. (auth)

19476 PARTIAL-WAVE ANALYSIS IN THE NNπ SYSTEM. Varma, V. S. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 42A: 87-108(1966).

A partial-wave analysis is carried out for bound-state or resonance scatterings in the three-particle NNπ system. This involves the evaluation of the angular operators which characterize the spin and angular dependence of interactions of the type $a + b \rightarrow a' + b'$, where the total spin of the initial and final states does not exceed 2. (auth)

19477 A PERIPHERAL MODEL WITH ABSORPTION FOR THE PROCESS $N + N \rightarrow N + N^*$. Margolis, B.; Rotsstein, A. (McGill Univ., Montreal). Nuovo Cimento (10), 42A: 179-84(1966).

The peripheral model recently introduced by Clegg for the process $N + N \rightarrow N + N^*$ is modified to include absorptive effects due to competition from other inelastic channels. The modified model is applied to the three nucleon isobars at 1238 Mev, 1512 Mev and 1688 Mev. With absorption, one finds that the theoretical values of the cross sections are in much better agreement with the experimental data. The results also justify the frequently used approximation that the complex phase shifts describing elastic scattering in the entrance and exit channels are the same and furthermore the value of the absorption parameter ν associated with these complex phase shifts is in excellent agreement with that obtained from the study of the elastic pp and $p\bar{p}$ scattering cross sections. (auth)

19478 INTERPRETATION OF ASYMMETRIES IN THE WEAK PION PRODUCTION. Karpman, G. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cimento (10), 42A: 190-2(1966).

It is shown that, under some general assumptions, effects of T violation can be distinguished from interference of final-state resonances in the neutrino production of mesons (π): $\nu + N \rightarrow l + N + \pi$. (M.H.R.)

19479 APPLICATION OF CURRENT COMMUTATION RELATIONS TO LEPTONIC DECAY OF MESONS. Iwasaki, Y. (Tokyo Univ.). Nuovo Cimento (10), 42A: 198-200 (1966).

Current commutation relations derived from the quark model are applied to leptonic weak decays of mesons. The relations between K_{e2}, K_{e3}, K_{e4}, and K_{e5} are obtained together with the relations between π_{e2} and π_{e3}. (M.H.R.)

19480 WEAK INTERACTIONS OF KAONS. Bell, J. S.; Steinberger, J. (CERN, Geneva). pp 195-222 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

A review on weak interactions of kaons is presented. Developments associated with CP violation are emphasized. Both phenomenology and experimental observations are considered. (D.C.W.)

19481 π-N PHASE SHIFTS FROM 300 TO 700 Mev. Cence, J. (Univ. of Hawaii, Honolulu). Contract AT(04-3)-511. Phys. Lett., 20: 306-8(Feb. 15, 1966).

A phase shift analysis for π-N scattering was carried out from 300 to 700 Mev. The $T = 3/2$ phase shifts are in qualitative agreement with previous results. However, it is found that the $T = 1/2$ phase shifts lie within ±45 deg up to 700 Mev. (auth)

19482 ALGEBRA OF CURRENTS AND THE MAGNETIC MOMENTS OF HYPERONS. Mathur, V. S.; Pandit, L. K. (Univ. of Rochester, N. Y.). Phys. Lett., 20: 308-10 (Feb. 15, 1966).

Using equal-time commutation relations of the strangeness-changing axial-vector "charges" with the isoscalar and isovector electromagnetic current densities, the magnetic moments of Σ^+ and Λ were calculated in terms of the kaon photoproduction amplitudes, which are evaluated using low lying baryon resonant states. The results agree very well with the experimental values. (auth)

19483 ANALYSIS OF HIGH-ENERGY MESON-BARYON ELASTIC SCATTERING. Kozlowsky, B.; Dar, A. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 20: 311-14(Feb. 15, 1966).

The applicability of the strong absorption model of nuclear elastic scattering, is demonstrated for the case of high energy meson-baryon elastic scattering. (auth)

19484 POLARIZATION IN MESON-BARYON ELASTIC SCATTERING AT HIGH ENERGIES. Dar, A.; Kozlowsky, B. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 20: 314-17(Feb. 15, 1966).

The strong absorption model is extended to describe the polarization angular distribution in high energy meson-baryon elastic scattering. (auth)

19485 STUDY OF THE Λ-p EFFECTIVE MASS SPECTRUM AND THE Λ LIFETIME. Buran, T.; Eivindson, O.; Skjeggestad, O.; Toefte, H.; Vegge, I. (Univ., Oslo). Phys. Lett., 20: 318-20(Feb. 15, 1966).

An enhancement is observed at M = 2220 Mev in the effective mass spectrum of Λ-p from multinucleon K^- captures in CF_3Br. Earlier reported Λ-p resonances are not observed. The Λ lifetime is estimated to be $\tau_\Lambda = (2.35 \pm 0.09) \times 10^{-10}$ sec. (auth)

19486 AN ORIGIN OF COMPLEX LIFETIMES OF POSITRONS ANNIHILATING IN METALS. Kugel, H. W.; Funk, E. G.; Mihelich, J. W. (Univ. of Notre Dame, Ind.). Phys. Lett., 20: 364-6(Mar. 1, 1966).

The second lifetime component for positrons annihilating in Al, Mg, Ni, and Cu is found to be absent or greatly reduced if chemical reaction between the source (^{22}Na in HCl solution) and the metal sample is prevented. (auth)

19487 DETERMINATION OF THE RATIO OF THE KNΛ AND KNΣ COUPLING CONSTANTS FROM BARYON EXCHANGE. Jarlskog, C.; Pilkuhn, H. (Univ. of Lund). Phys. Lett., 20: 428-9(Mar. 1, 1966).

The ratio $G^2_{KN\Lambda}/G^2_{KN\Sigma}$ was computed independently from two different pairs of reactions. It provides an accurate value for the ratio of F and D couplings in SU_3. (auth)

19488 ON A TEST OF ELECTROMAGNETIC T VIOLATION IN CHARGED K DECAYS. Gervais, J-L. (Faculte des Sciences, Orsay, France); Iliopoulos, J.; Kaplan, J. M. Phys. Lett., 20: 432-4(Mar. 1, 1966).

The transverse μ-polarization in $K \rightarrow \mu + \nu + \gamma$ is calculated. T-violation is introduced through the $KK^*\gamma$ vertex. Since the maximum polarization is found to be 57%, this decay may provide a test of T-conservation in electromagnetic interactions. (auth)

19489 STRUCTURE OF THE Λ-N WEAK INTERACTION. Panchapakesan, N. (Univ. of Chicago). Phys. Lett., 20: 435-7(Mar. 1, 1966).

The assumption that weak hamiltonian transforms like a member of the octet is found inadequate to explain the structure of the interaction $\Lambda + N \rightarrow N + N$ obtained by Bloch and Dalitz. Inclusion of components of the 27 representation is found necessary. (auth)

19490 ARE SPIN-ZERO MESONS BOUND STATES OF TWO SPIN-ZERO MESONS? Massidda, V. M.; Pignotti, A. (Facultad de Ciencias Exactas y Naturales, Buenos Aires). Phys. Lett., 20: 437-8(Mar. 1, 1966).

It is shown that the appearance of S-wave bound states in some N/D calculations for the scattering of two spinless mesons is accidental, and does not explain the dynamical origin of spin zero mesons. (auth)

19491 STRONG-INTERACTION DYNAMICS WITH VERTICES INVARIANT UNDER THE COLLINEAR GROUP. Gatto, R.; Veneziano, G. (Univ., Florence). Phys. Lett., 20: 439-40(Mar. 1, 1966).

The consistency of a dynamical theory, fulfilling analyticity and unitarity, with vertices invariant under the collinear subgroup of SU_6 is demonstrated for low-energy pion processes. The relation is pointed out for the current algebra approach. The question of the correct definition of the unstable particle couplings is clarified. (auth)

19492 ASYMMETRY AND MULTIPLE SCATTERING IN NUCLEON-DEUTERON COLLISIONS. Benoist-Gueutal, P. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 20: 525-7(Mar. 15, 1966). (In French).

A development of the transition operator in terms of multiple scattering is proposed for nucleon–deuteron collisions taking into account exactly the effects of asymmetry. (tr-auth)

19493 CHECK OF THEORETICAL PREDICTIONS FOR THE MULTIPOLE $E_{1+}^{\frac{3}{2}}$ IN π^0 PHOTOPRODUCTION. Schmidt, W. (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger.); Wunder, H. Phys. Lett., 20: 541-4 (Mar. 15, 1966).

From some recent evaluations of the partial wave dispersion relations for the multipoles $E_{1+}^{\frac{3}{2}}$ and $M_{1+}^{\frac{3}{2}}$ in pion-photoproduction the ratio $E_{1+}^{\frac{3}{2}}/M_{1+}^{\frac{3}{2}}$ is taken and checked against experimental results for π^0-production with unpolarized and plane-polarized γ's in the region of the first pion-nucleon resonance. (auth)

19494 ESTIMATE OF QUARK PRODUCTION IN HIGH-ENERGY NUCLEAR INTERACTIONS. Domokos, G.; Fulton, T. (John Hopkins Univ., Baltimore). Phys. Lett., 20: 546-8(Mar. 15, 1966).

A statistical model estimate is made of quark production in p-p collisions. The cross section is given as a function of quark mass as well as the counting rate of production by cosmic rays, assuming that the primaries consist entirely of protons. (auth)

19495 RECOIL-PROTON POLARIZATION IN π^--p ELASTIC SCATTERING AT 365 Mev. Dickinson, D. F.; Helland, J. A.; Perez-Mendez, V. (Univ. of California, Berkeley). Phys. Lett., 20: 549-51(Mar. 15, 1966). (UCRL-11690(Rev.)).

The polarization of the recoil proton at this energy depends on the interference of the P_{33} phase shift with the P_{11} and S_{11} phase shifts. The measured values indicate the existence of a large P_{11} phase shift. The polarization was measured by scattering from carbon blocks in spark chambers using a Vidicon scanner to record the data. (auth)

19496 NUCLEAR BREMSSTRAHLUNG FROM p-p AND p-d INTERACTIONS NEAR 140 Mev. Edgington, J. A. (Cambridge Univ., Eng.); Rose, B. Phys. Lett., 20: 552-3(Mar. 15, 1966).

Differential cross sections for bremsstrahlung were measured for p-p and p-d interactions near 140 Mev. The total cross sections are, respectively, -0.01 ± 0.06 μb and 8 ± 1 μb for photon energies above 30 Mev and -0.06 ± 0.05 μb and 4.0 ± 0.3 μb for photon energies above 40 Mev. These results are compared with those of other experimenters and with theoretical predictions. (auth)

19497 CHARGE EXCHANGE AND THE REACTION $\bar{p} + p \rightarrow \bar{n} + n + \pi^+ + \pi^-$ OF 3.0-, 3.6-, AND 4.0-Gev/c ANTIPROTONS. Czyzewski, O.; Escoubes, B.; Goldschmidt-Clermont, Y.; Guinea-Moorhead, M.; Morrison, D. R. O.; De Unamuno-Escoubes, S. (CERN, Geneva). Phys. Lett., 20: 554-7(Mar. 15, 1966).

The angular distribution of antiproton-proton charge exchange, measured around 3.5 Bev/c, is compared to the proton-neutron charge exchange. When the neutron and antineutron are produced together with two additional charged pions, evidence is found for isobar formation and their cascade decay. (auth)

19498 ANNIHILATIONS OF 5.7-Gev/c $\bar{p}$ IN HYDROGEN INTO FOUR CHARGED PIONS. Accensi, A.; Alles-Borelli, V.; French, B. (and others) (CERN, Geneva). Phys. Lett., 20: 557-9(Mar. 15, 1966).

Annihilations of 5.7 Bev/c antiprotons in hydrogen into four charged pions were studied. Production of ρ^0 and f^0 mesons and a possible enhancement in both $\pi^\pm\pi^\pm$ and $\pi^+\pi^-$ mass distributions at 1.54 Bev is seen. Upper limits for quasi 2-body annihilations are given. (auth)

19499 THEORY OF POSITRON ANNIHILATION IN REAL METALS. Carbotte, J. P. (Cornell Univ., Ithaca, N. Y.). Contract NONR-401(38). Phys. Rev., 144: 309-18(Apr. 8, 1966).

A theory of positron annihilation applicable to real metals is developed. It is based on a band model for a solid and the ladder approximation for the electron-positron Green's function. The Bloch character of the positron as well as the conduction-band single-particle wave functions are included. The core electrons are treated within the tight-binding approximation. Throughout, the effect of the direct Coulomb coupling between the annihilating pair is stressed. The general formulas are then used to derive a theory of core annihilation. In the course of the derivation it was necessary to make a number of simplifying assumptions which restrict the theory to simple metals. It is found that the contribution to the partial annihilation rate R[p] coming from a core electron is proportional to the square of the sum of two terms: the usual pth Fourier component of the product of the positron and core function plus another term accounting for the polarization of the ion core by the positron. After studying core annihilation in detail using an idealized model for the unoccupied electron Bloch states in sodium, it is concluded that the second term is just as important as the first, although it has never been included in past treatments of this problem. Unfortunately the model is too crude to give quantitative results. An accurate calculation of core annihilation is very much more difficult than the corresponding computation of annihilation in a conduction-electron gas. (auth)

19500 FINAL-STATE INTERACTIONS IN THE REACTION $^3He(^3He,2p)^4He$. Blackmore, E. W.; Warren J. B. (Univ. of British Columbia, Vancouver). Phys. Rev. Lett., 16: 520-2(Mar. 21, 1966).

Proton-proton coincidence spectra from the reaction $^3He(He\text{-}3,2p)^4He$ at 1.15 and 5.00 Mev were measured at small angles between the two protons. Evidence of proton-proton interaction was observed. Preliminary calculations indicated that a nuclear attraction between the two protons must be considered, as well as the Coulomb repulsion, in order to explain the observed structure. (D.C.W.)

19501 EXISTENCE OF THE TRINEUTRON. Mitra, A. N. (Univ. of Delhi); Bhasin, V. S. Phys. Rev. Lett., 16: 523-5(Mar. 21, 1966).

A three-body analysis of n^3 was performed using an ordinary n-n force in the ^3P state. The results indicate not only that the required strength of this force is well below the limit for a ^3P bound n^2 state but that it is also quite compatible with the magnitude of the ^3P phase shifts in N-N scattering. (D.C.W.)

19502 POLARIZATION IN p-p ELASTIC SCATTERING FROM 0.75 TO 2.8 Gev. Longo, Michael J.; Neal, Homer A.; Overseth, Oliver E. (Univ. of Michigan, Ann Arbor). Contract NONR 1224(23). Phys. Rev. Lett., 16: 536-8(Mar. 21, 1966).

The polarization parameter in p-p elastic scattering was measured at six energies in the range from 0.75 to

2.80 Bev. The results were compared with other experimental data. (D.C.W.)

19503 MEASUREMENT OF THE ELECTRON SPECTRUM FROM MUON DECAY, AND ITS IMPLICATIONS. Ehrlich, R. D. (Univ. of Chicago); Fryberger, D.; Powers, R. J.; Sherwood, B. A.; Telegdi, V. L.; Bounin, J. Contract Nonr 2121(25). Phys. Rev. Lett., 16: 540-3 (Mar. 21, 1966).

The electron spectrum from muon decay was measured using a nonfocusing spectrometer. The results were used to test the predictions of the V-A theory. (D.C.W.)

19504 REAL PART OF THE PROTON-NEUTRON SCATTERING AMPLITUDE FROM AN SU(3) REGGE-POLE MODEL. Barger, V.; Olsson, M. (Univ. of Wisconsin, Madison). Contracts AT(11-1)-881; COO-881-59. Phys. Rev. Lett., 16: 545-8(Mar. 21, 1966).

The contributions to the real part of the forward elastic-scattering amplitude f(s,o) were investigated. It was shown that the condition $\rho_{pn} \approx \rho_{pp}$ (ρ = Re f(s,o)/Im f(s,o)) is in essential agreement with the prediction of a Regge-pole model. (D.C.W.)

19505 POLARIZATION OF RECOIL PROTONS IN π-p ELASTIC SCATTERING AT 1-3 Gev/c. Minami, Shigeo (Osaka City Univ.). Phys. Rev. Lett., 16: 549-52(Mar. 21, 1966).

The polarization of recoil protons in π-p elastic scattering at 1 to 3 Bev/c is discussed by taking into account the effects of a resonant state N* in the π-N system. (G.O.Y.)

19506 DETERMINATION OF ρ_0-NUCLEON TOTAL CROSS SECTION FROM COHERENT PHOTOPRODUCTION. Drell, S. D. (Stanford Univ., Calif.); Trefil, J. S. Phys. Rev. Lett., 16: 552-5(Mar. 21, 1966).

The total ρ^0-N cross section was evaluated on the basis of a calculation of the forward amplitude for ρ^0 photoproduction on nuclei. The similarity between ρ^0 photoproduction and the scattering of mesons (π) and protons was used. (D.C.W.)

19507 K_S REGENERATION AND $K_L \rightarrow \pi^+ + \pi^-$ DECAY IN THE 80-INCH HYDROGEN BUBBLE CHAMBER. Firestone, A. (Yale Univ., New Haven); Kim, J. K.; Lach, J.; Sandweiss, J.; Taft, H. D.; Barnes, V.; Foelsche, H. W. J.; Morris, T.; Oren, Y.; Webster, M. Phys. Rev. Lett., 16: 556-9(Mar. 21, 1966).

The results of an investigation of K_2^0 regeneration and of the decay $K_2^0 \rightarrow \pi^+ + \pi^-$ are presented. In general, the results on K_2^0 decay confirm previous experimental results. The relative phase of the $K_2^0 \rightarrow \pi^+ + \pi^-$ and the $K_1^0 \rightarrow \pi^+ + \pi^-$ amplitudes was measured by using interference with hydrogen-regenerated mesons (K_1^0). (D.C.W.)

19508 SIGN OF THE n-p MASS DIFFERENCE. Fried, H. M.; Truong, T. N. (Brown Univ., Providence). Phys. Rev. Lett., 16: 559-62(Mar. 21, 1966).

The n-p mass difference is calculated using the Gell-Mann and Low representation. (D.C.W.)

19509 MEASUREMENTS OF NEUTRON FORM FACTORS. Stein, P.; Binkley, M.; McAllister, R.; Suri, A.; Woodward, W. (Cornell Univ. Ithaca, N. Y.). Phys. Rev. Lett., 16: 592-4(Mar. 28, 1966).

An experimental investigation of the electromagnetic neutron form factors at momentum transfers of 5.5, 10.0, and 14.5 F^{-2} by measuring the differential cross section for quasi-elastically scattered electrons by deuterium in coincidence with a scattered nucleon in the reaction e + d $\rightarrow$ e + p + n is described. (B.G.D.)

19510 REGGE-POLE ANALYSIS OF $\pi^+ + n \rightarrow \omega + p$. Barmawi, M. (Univ. of Chicago). Phys. Rev. Lett., 16: 595-7(Mar. 28, 1966). (COO-264-296; EFINS-65-111).

It is shown that the Regge-pole model can well explain all aspects of ω production, provided an axial-vector meson trajectory is included, which gives rise to a resonance corresponding to the proposed B meson. (B.G.D.)

19511 ROLE OF EQUAL-TIME AXIAL-VECTOR CURRENT COMMUTATORS IN SUM RULES. Suura, H.; Simmons, L. M. Jr. (Univ. of Minnesota, Minneapolis). Phys. Rev Lett., 16: 598-600(Mar. 28, 1966). (COO-1371-24).

A discussion is presented pointing out that the axial-vector current-current commutation relation, proposed to express the universality free from complexities of local field theories, can still be interpreted as the bare Born term for a certain amplitude, and that it serves as a subtraction constant at infinity. (B.G.D.)

19512 2^+ MESONS AND HIGH-ENERGY SCATTERING. Desai, Bipin R. (Univ. of California, Riverside); Freund, Peter G. O. Phys. Rev. Lett., 16: 622-5(Apr. 4, 1966).

A discussion is presented on whether the SU(3) nonet of the nine $J^P = 2^+$ mesons in existence explains the experimental behavior of the sum of the particle and antiparticle total cross sections in the elastic scattering process A + B $\rightarrow$ A + B, where A stands for baryons and B stands for baryons or mesons, or whether additional Regge trajectories are needed. (B.G.D.)

19513 POSSIBLE TEST OF T-INVARIANCE VIOLATION IN ELECTROMAGNETIC INTERACTIONS. Karpman, G. (Institut de Physique Nucleaire, Orsay, France); Leonardi, R.; Strocchi, F. Phys. Rev. Lett., 16: 633-5(Apr. 4, 1966).

A possible test of T-invariance violation in electromagnetic interactions is discussed by considering the pion photoproduction reaction $\gamma + N \rightarrow N' + \pi$ which is mainly governed by the N^*_{33} intermediate state. T-invariance violating contributions may arise from $\gamma - N^* - N$ vertex. Hermiticity and gauge invariance do not exclude T-invariance violating terms in this case. These could be observed by measuring a correlation function which may have important contributions from final-state strong interactions. In order to detect T-invariance violations the separate contributions are investigated. (B.G.D.)

19514 TIME-DOMAIN ANALYSIS OF PHOTON BEAMS. Troup, G. J. (Monash Univ., Clayton, Victoria, Australia). Proc. Phys. Soc. (London), 87: 361-70(Feb. 1966).

The analysis of photon beams in terms of the time intervals between photon counts is discussed; in particular, the cases of beats and of sinusoidal amplitude modulation are considered. (auth)

19515 AN INCONSISTENCY IN LOW-ENERGY PION PHYSICS. Donald, R. A.; Evans, W. H.; Hart, W.; Mason, P.; Plane, D. E.; Read, E. J. C. (Univ. of Liverpool). Proc. Phys. Soc. (London), 87: 445-53(Feb. 1966).

Results are reported of measurements of charge-exchange scattering of negative pions by protons, and of elastic scattering of negative pions by protons, at a mean energy of 39 Mev. These results, combined with those obtained from an earlier experiment at 35 Mev, reveal an inconsistency between the hypothesis of charge independence and measured values of the s-wave scattering lengths obtained from elastic scattering and from charge-exchange scattering. (auth)

19516 PROPOSAL OF THE EXPERIMENTAL TEST OF THE SUBSTITUTION LAW. Ono, Ken-ichi (Tokyo Univ.). Sci. Pap. Coll. Gen. Educ., Univ. Tokyo, 15: 133(Dec. 1965).

It is pointed out that if nucleons are particles for which the substitution law does not hold the processes $p \rightarrow p + \gamma$ and $\gamma \rightarrow p + \bar{p}$ can have different coupling constants. Since the coupling constant for the former process is the unit charge, e, the coupling constant for the second process is also expected to be an integral multiple of e. It is proposed that the definite measurement of the cross section for the pair production of protons be made from this point of view. (J.F.P.)

19517 THE SEARCH FOR NEUTRINOS. Levy-Leblond, J.-M. (Univ. Paris, Orsay, France). Sci. Progr.-Nature, No. 3368, 449-57(Dec. 1965). (In French).

The enigma of radioactivity that led to the hypothesis of the neutrinos by Pauling is described. The experimental

evidence of the neutrinos is given. The problem of existence of two types of neutrinos is discussed and the experiments suggested to solve this problem are described. (J.S.R.)

19518 ISOTOPIC RELATIONS FOR PHOTOPRODUCTION PROCESSES OF MESONS. Rekalo, M. P. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 11: 3-11 (Jan. 1966). (In Ukrainian).

Isotopic relation between amplitudes of processes $\gamma + N \to \Sigma + K + \pi$, $\gamma + N \to N + \pi + \pi$, $\gamma + d \to \Sigma + N + K$ are derived. The cases of production of pair particles in the final state with a definite value of isotopic spin are investigated in detail. The isotopic relations for various pole mechanisms of the investigated processes are considered. (auth)

19519 CALCULATION OF THE MASSES OF SOME BARYON MULTIPLETS. Kostyrko, I. I. (Inst. of Mathematics, Kiev). Ukr. Fiz. Zh., 11: 20-4(Jan. 1966). (In Ukrainian).

The masses of baryon resonances of $(7^+/2)$- and $(11^+/2)$-multiplets are calculated on the basis of the equidistance of the mean masses of neighboring baryon multiplets with equal parity and on the basis of the mass formulas. A new mass structure is proposed for the $(5^+/2)$-multiplet. (auth)

19520 THE DYNAMICAL MODEL OF THE VECTOR MESON φ AND THE VALUES OF THE COUPLING CONSTANTS $f^2_{\varphi K\bar{K}}$, $f^2_{\omega K\bar{K}}$, AND $f^2_{\rho K\bar{K}}$. Chen, Chang-chia. Wu Li Hsueh Pao, 21: 1996-2003(Dec. 1965). (In Chinese).

It is assumed that the vector meson (φ) is a resonance which is formed from the $K\bar{K}$ scattering by exchange of ρ, ω, and φ itself. The method of N/D of the double dispersion relation is used and the experimental values of the masses are known for the ρ, ω, and exchange φ. The partial wave amplitude of the $K\bar{K}$ scattering is given approximately. When it is required for the partial wave amplitude to give in turn the correct position and width of the resonance, the relations for the coupling constants $f^2_{\varphi K\bar{K}}$, $f^2_{\omega K\bar{K}}$, and $f^2_{\rho K\bar{K}}$ are found and the values available for them are determined. (auth)

19521 INFLUENCE OF PION RESONANCES ON LOW ENERGY PROTON-PROTON SCATTERING. Koepp, G. (II. Institut fuer Experimentalphysik, Hamburg). Z. Phys., 191: 273-301(1966). (In German).

Coupling constants of various scalar and vector mesons to the nucleon are determined from empirical proton-proton partial wave amplitudes of high angular momenta. Various fits are described and compared with predictions of unitary symmetry schemes. (auth)

19522 APPLICATIONS OF DISPERSION RELATIONS TO PION-NUCLEON AND PION-PION PHENOMENA. Hamilton, J. (Univ. Coll., London). pp 281-369 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

The use of forward and fixed momentum transfer dispersion relations to determine the main parameters of low-energy π-N physics from experimental data is discussed, together with the use of partial-wave π-N dispersion relations to derive information about the low-energy π-π interactions, especially the T = 0, J = 0, π-π interaction. Various topics in the solution of partial-wave dispersion relations are also covered. 51 references. (D.C.W.)

19523 BOOTSTRAPS. Zachariasen, F. (California Inst. of Tech., Pasadena). pp 371-409 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

The N/D method is outlined, and the bootstrapping of the meson (ρ) from a pair of pions is discussed in detail. Several methods for bootstrapping an entire Regge trajectory are outlined, and the possibility that internal symmetries originate in the bootstrap is discussed. (D.C.W.)

19524 DALITZ PLOT ANALYSIS OF THE FORM FACTORS RATIO IN $K^+_{\mu_3}$ DECAY [Thesis]. Murphree, David Limon. Madison, Wis., Univ. of Wisconsin, 1965. 87p.

The ratio of the form factors, $\xi = f-/f+$, of the strangeness-changing vector current of the $K^+_{\mu_3}$ decay is determined. This is accomplished by a Dalitz plot analysis of the pion and muon kinetic energies of $K^+_{\mu_3}$ decays with completely specified kinematics. The data are consistent with a real value of ξ. An ambiguity in the value of Re(ξ) results: Re(ξ) = +0.7 ± 0.5 or Re(ξ) = −4.7 ± 0.3. An analysis independent of scanning bias in the μ^+ energy indicates that the most likely value for ξ is Re(ξ) = +0.7 ± 0.5 and Im(ξ) = 0.0 ± 1.6. (Dissertation Abstr.)

19525 THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON [Thesis]. Pagels, Heinz Rudolf. Stanford, Calif., Stanford Univ., 1965. 119p.

The problem of determining the anomalous moment of the electron, g-2, by analytically continuing the form factors in the invariant mass of one of the electrons is examined. Dispersion theory is used to relate the absorptive amplitude to Compton scattering in the approximation of keeping only electron-photon intermediate states and to determine the anomalous moment from an energy integral over the absorptive part. From the exact Thomson limit it is shown through a purely non-relativistic calculation that a major part of the $\alpha/2\pi$ correction arises from the threshold behavior of the Compton amplitude. The calculation is refined by including the exact pole terms in the Compton amplitude in accord with the low-energy theorem on Compton scattering. Including the correct moment to order α^2 gives the prediction $+0.1\ \alpha^3/\pi^3$ for the correction to order e^6. The difference g^μ-g^e receives a simple physical interpretation by examining the dominant forces in the $\mu^+\mu^-$ and e^+e^- scattering amplitudes. As it was possible to relate the electron anomalous moment to the exact threshold behavior of the Compton amplitude can the anomalous moments of the nucleons be related to the Kroll-Ruderman theorem on low energy pion photoproduction. As a consequence the anomalous moments of the nucleons are equal in magnitude and opposite in sign. By including only pion nucleon states 3 $m_\pi c^2$ above threshold in the intermediate state sum 90% of the observed nucleon moments are reproduced. (A.G.W.)

19526 ELECTROMAGNETIC FORM FACTORS OF THE PROTON [Thesis]. Janssens, Thomas Jean. Stanford, Calif., Stanford Univ., 1965. 124p.

The electromagnetic form factors of the proton were determined from precision elastic electron-proton differential cross sections measured at energies ranging from 259 to 1022 Mev at angles lying between 45° and 145°. The four-momentum transfer squared (q^2) in these measurements varied in value from $4F^{-2}$ to $30F^{-2}$. One hundred fifteen separate cross sections were measured. In general a number of measurements were made at the same value of q^2 in order to separate experimentally the effects of charge and magnetic scattering. The accuracy of the measurements varied from 2% to 4%. The results are compared to theoretical expressions based on a Clementel-Villi type model, involving the well-known isotopic vector and scalar pion resonances. Comparisons are also made with the data of other experimental groups. (Dissertation Abstr.)

19527 HIGH ENERGY SEMILEPTONIC REACTIONS. Adler, Stephen L. (Harvard Univ., Cambridge, Mass.). 21p. (CONF-651043-4). ORAU. Gmelin, AED-CONF-65-320-2.

From Weak Interactions Conference, Argonne, Ill.

The theory of semileptonic interactions, as it pertains to high-energy neutrino experiments, is discussed. Tests of CP invariance in high-energy semileptonic weak interactions are considered, as well as tests of the postulates of the theory. (D.C.W.)

19528 THEORETICAL REMARKS ON CP NON-INVARIANCE. Lee, T. D. (Columbia Univ., New York). 4p. (CONF-651015-7). ORAU. Gmelin, AED-CONF-65-312-15.

From American Physical Society, Chicago.

Some theoretical implications of the CP non-invariance in $K_2^0 \rightarrow \pi^+ + \pi^-$ decay are outlined. (G.O.Y.)

19529 NUCLEON FORM FACTORS AND EVIDENCE FOR THE VALIDITY OF QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. Pipkin, F. M. (Harvard Univ., Cambridge, Mass.). pp 61-91 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The experimental status of the general subject of electromagnetic interactions is reviewed. The information on the nucleon form factors is discussed, together with the evidence for the validity of quantum electrodynamics. (D.C.W.)

19530 BARYON RESONANCES. Peyrou, Ch. pp 131-54 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

A review of some recent observations on the production, decay, and quantum numbers of baryon resonances is presented. The analyses of the data are considered. (D.C.W.)

19531 RESONANT STATES AND STRONG INTERACTIONS. Dalitz, R. H. (Clarendon Lab., Oxford). pp 157-81 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The systematics of baryon states and meson states are discussed in terms of the quark model and SU(3) symmetry. (D.C.W.)

Field Theory, Scattering Theory, and Symmetries

See also Elementary Particles and Radiations

19532 (ANL–7130, pp 421-9) SU(3) AND NONLEPTONIC WEAK INTERACTIONS. Lee, Benjamin W. (Pennsylvania Univ., Philadelphia).

The approximation of CP invariance is used to discuss nonleptonic weak interactions. (M.O.W.)

19533 (BNL–9934) BOSON RESONANCES. Samios, N. P. (Brookhaven National Lab., Upton, N. Y.). Jan. 1966. Contract AT(30-2)-Gen-16. 14p. (CONF-660105–2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 3rd Conference on Symmetry Principles, Coral Gables, Fla.

An experimentalist's view on the theory of boson resonances is presented. The discussion gives the author's view as what is believed to exist, what is not verified, and what the possible difficulties are. (M.O.W.)

19534 (IC–66/19) ATTEMPTS AT UNDERSTANDING THE MASS SPECTRA OF ELEMENTARY PARTICLES. Bisiacchi, G.; Fronsdal, C. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 1966. 20p. Dep. mn.

Answers to the following 5 questions are presented and discussed; (1) is there a sense in which the mass operators for baryons and for mesons can be said to be equal, (2) does the mass operator transform like a component of an irreducible SL (6,c) tensor, (3) how does the mass operator transform under Lorentz transformations, (4) in the framework of SL (6,c), can mixing between different SU(6) representations be avoided, and (5) what are the qualitative features of the mass spectrum for higher SU(6) multiplets. (M.O.W.)

19535 (IC–66/23) ON THE REPRESENTATIONS AND COUPLING OF THE U(6,6) TOWER. Akyeampong, D. A. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 21, 1966. 13p. Dep. mn.

Some representations of $U(\nu,\nu) \otimes U(\nu,\nu)$ are constructed and the eigenvalue problem involved in the approach is solved and shown to lead, under suitable boundary conditions, to a discrete spectrum. The coupling of the different $U(\nu,\nu)$ rungs of the tower is also discussed. (auth)

19536 (IC–66/25) PARTIAL CONSERVATION OF TENSOR CURRENT AND ELECTROMAGNETIC DECAYS. Krolikowski, W. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 25, 1966. 8p. Dep. mn.

Meson electromagnetic decays are discussed on the grounds of a hypothesis called "the partial conservation of a tensor current." (auth)

19537 (IC–66/26) P-WAVE NON-LEPTONIC DECAYS OF HYPERONS IN SU(6) AND REPRESENTATION MIXING. Santhanam, T. S. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 28, 1966. 5p. Dep. mn.

Assuming that the final baryon in the p-c nonleptonic hyperon decays belongs to the completely antisymmetric representation, it is shown that $B(\Sigma^-) = 0$ without assuming anything else. (auth)

19538 (IC–66/27) ELECTRIC CHARGE FORM FACTOR ACCORDING TO SL(6,C). Cocho, G.; Fronsdal, C.; Ar-Rashid, Harun; White, R. (International Centre for Theoretical Physics, Trieste (Italy)). Mar. 31, 1966. 9p. Dep. mn.

An investigation of the group $P \cdot SL(6,C)$ (semidirect product of the Poincaré group P with SL(6,C)) was made. The electric charge form factor was derived using this group. (M.O.W.)

19539 (JINR–E-2544) DISPERSION SUM RULES AND SU(6) SYMMETRY. [PART] II. Aznauryan, I. G.; Soloviev, L. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 16p. Dep. mn.

On the basis of the sum rules following from the usual one-dimensional dispersion relations, the following were obtained: (1) relations between the pion-baryon coupling constants and the decay widths of the nearest resonances, (2) relations between the magnetic moments of baryons and those of the radiation decays of the resonances, and (3) the relations for the form factors, which together with $SU(6)_w$ symmetry lead to the equality $G_M^{(p)}(R^2)/G_E^{(p)}(R^2) = 3$. The results are compared with experiment and with predictions of SU(6) symmetry. (auth)

19540 (UCRL–14647-T) PROPERTIES OF PARTICLE REACTIONS IN THE ABSENCE OF DYNAMICAL INFORMATION. Moravcsik, Michael J. (Lawrence Radiation Lab., Univ. of California, Livermore). Jan. 1966. Contract W-7405-eng-48. 28p. (CONF-660209–3). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Conference on Intermediate Energy Physics, Williamsburg, Va.

A phenomenological framework is discussed which is quite well applicable to all spins and to all energies and thus also to intermediate energies. The discussion is carried out in terms of the M-matrix of a reaction. The advantages are pointed out of the phenomenological description of reactions in terms of their invariant amplitudes. (M.O.W.)

19541 (UR–875-121) SOME APPLICATIONS OF THE ALGEBRA OF CURRENTS. Pandit, L. K. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). Feb. 7, 1966. Contract AT(30-1)-875. 22p. (CONF-660105–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From 3rd Conference on Symmetry Principles, Coral Gables, Fla.

Various applications of the algebra of currents theory are briefly discussed. In particular, $k\pi$ interactions, decays of vector mesons, and the evaluation of anomalous magnetic moments are discussed. (M.O.W.)

19542 PEDESTRIAN COVARIANT PHASE-SPACE INTEGRATION. Williamson, W. Jr. (Univ. of Michigan, Ann Arbor). Amer. J. Phys., 33: 987-94(Dec. 1965).

Two- and three-body Lorentz invariant phase-space volumes are given in terms of covariant variables. Examples in the use of covariant variables for two- and

three-body final-state problems are given and methods that may reduce the labor in the analytic integrations for involved problems are discussed. Four-body phase-space procedures are summarized. (auth)

19543 MULTICOMPONENT MOMENTA AND NONCONSERVATION OF ANGULAR MOMENTUM. Krolikowski, W. (Inst. for Nuclear Research, Warsaw. Univ. of Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 13: 733-5(1965).

The problem of nonconservation of total physical angular momentum in theories involving unphysical momenta is considered. It is pointed out that the total physical momentum can be conserved. With SU(6) as an example it is shown that the total physical angular momentum (i.e., spin plus orbital angular momentum) is, in general, not conserved in a theory which is symmetric under SU(6) and involves unphysical momenta transforming under SU(6) according to the regular representation of SU(6). (J.F.P.)

19544 INTER-TRANSFORMATION RULES FOR THE FOUR DIRAC BASE SPINORS. Longe, Pierre (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 34: 646-55(1965).

Inter-transformation rules between the four base spinors of the Dirac spinor space are established from geometrical considerations about the space-time symmetries and the charge conjugation. The invariance of these rules under these symmetries is investigated. (auth)

19545 SOME REMARKS ABOUT THE LOCALIZATION OF STATES IN A QUANTUM FIELD THEORY. Schlieder, Siegfried (Univ. of Maryland, College Park). Commun. Math. Phys., 1: 265-80(1965).

For the case of a field theory with a nuclear space of test functions (for instance, the space of strongly decreasing test functions) compact sets of states are constructed; these correspond to sets of localized states. Only such states are considered which are elements of a fixed subspace of the entire Hilbert space. This subspace belongs to the m-point functions of order less than a certain fixed 2n. (auth)

19546 LOCAL RINGS AND THE CONNECTION OF SPIN WITH STATISTICS. Borchers, H. J. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 1: 281-307(1965).

The usual investigations of the connection of spin and statistics start with the hypothesis that there exist only fields either commuting or anti-commuting for spacelike separations. Starting from local rings of measurements it is shown that this hypothesis can be added without loss of generality. (auth)

19547 WHEN DOES A QUANTUM FIELD THEORY DESCRIBE PARTICLES? Haag, R.; Swieca, J. A. (Univ. of Illinois, Urbana). Commun. Math. Phys., 1: 308-20(1965).

A criterion is given which has to be satisfied in a quantum field theory in order to allow a complete particle interpretation of the theory. The notion of "essentially localized states" in field theory is re-examined. (auth)

19548 A DEGENERATE PRINCIPAL SERIES OF SL(3,R). Hillion, Pierre (Institut Henri-Poincare, Paris). Compt. Rend., Ser. A, 262: 96-9(Jan. 3, 1966). (In French).

The existence of a degenerate principal series of irreducible unitary representations of SL(3,R) is established. (tr-auth)

19549 INTEGRAL REPRESENTATION FOR TWO-PARTICLE AMPLITUDE IN THE NON-RELATIVISTIC CASE. Mestvirishvili, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Dokl. Akad. Nauk SSSR, 164: 301-4(Sept. 11, 1965). (In Russian).

The system proposed by L. D. Faddeev consisting of interlocking equations for specifying the three-body problems, in which particles interact with pair forces, makes use of a diagrammatic technique for the analysis of two-particle amplitudes. An attempt was made to develop an integral representation for two-particle amplitudes outside of the energy surface for a nonrelativistic case. The mathematical derivation of this representation was based on the analytical properties of triangular field-theory diagrams. (TTT)

19550 ON THE L-S BASIS OF THE POINCARE GROUP FOR THE CASE OF NONZERO REST MASS. Chakrabarti, A. (Ecole Polytechnique, Paris). J. Math. Phys., 7: 426-30(Mar. 1966).

The action of the generators of the Poincaré group on the basis functions spanning an irreducible representation $[m^2, s^2]$ $(m > 0)$ and labeled by the eigenvalues of the energy, orbital angular momentum and spin, and the projections on a fixed axis of the two latter are considered. The explicit canonical representation of the generators are used. The formulas are derived first for the zero-spin case and then for the general case. It is shown that our L–S basis permits a much more compact and systematic derivation of the formulas than the basis involving total angular momentum and helicity, which is considered by Lomont and Moses. The separation of the orbital and spin parts allows us also to display explicitly the role played by the "canonical" definition of spin. (auth)

19551 A NEW METHOD IN THE THEORY OF POTENTIAL SCATTERING. Gilbert, R. P.; Shieh, S. Y. J. Math. Phys., 7: 431-3(Mar. 1966).

A new method is given for investigating the position, number, and type of singularities the scattering amplitude may have as a function of complex momentum transfer. The advantage of this method over ones relying on the Watson transform is that one needs only to know the partial amplitudes for physical values of the angular momentum. (auth)

19552 ON THE COUPLING AND RECOUPLING OF RELATIVISTIC STATES. Goldberg, Haim (Univ. of Rochester, N. Y.). J. Math. Phys., 7: 434-42(Mar. 1966). (UR-875-84).

Systems containing more than two relativistic particles are analyzed from the point of view of irreducible representations of the Poincaré group. Corresponding Clebsch–Gordan coefficients are calculated for three-particle systems, and recoupling functions (which are the analog of the Racah coefficients) are defined. (auth)

19553 GEOMETRIZATION OF A COMPLEX SCALAR FIELD. I. ALGEBRA. Penney, R. (Ford Motor Co., Dearborn, Mich.). J. Math. Phys., 7: 479-81(Mar. 1966).

The necessary and sufficient conditions that a Ricci tensor should algebraically represent the energy tensor of a complex scalar field are given. (auth)

19554 FUNCTIONAL DIFFERENTIAL CALCULUS OF OPERATORS. II. Rohrlich, F.; Wilner, M. (Syracuse Univ., N. Y.). J. Math. Phys., 7: 482-93(Mar. 1966).

The calculus of operators developed previously is carried through in momentum space. The differential quotient, i.e., the derivative of an operator with respect to a free-field operator is expressed algebraically by means of generalized functions and certain commutators. No recourse is made to configuration space but the resultant calculus in p-space is related to the previously developed one in x-space by means of Fourier transforms. The calculus is presented for spins 0, $\frac{1}{2}$, and 1. The difficulties that were encountered before in the calculus for charged vector fields are resolved by working with a field equation which incorporates the supplementary condition needed to eliminate the spin-zero components. (auth)

19555 EUCLIDEAN QUANTUM FIELD THEORY. I. EQUATIONS FOR A SCALAR MODEL. Symanzik, K. (New York Univ., N. Y.). J. Math. Phys., 7: 510-25 (Mar. 1966).

The analytic continuations to imaginary time of the Green's function of local quantum field theory define Euclidean Green's functions. Use of the proper-time method allows to represent these functions as multiple Wiener integrals of functionals that obey infinite systems of coupled integral equations, which are similar to, and for the particular model of a complex scalar field in quad-

rilinear self-interaction considered here a limiting case of, systems studied in quantum statistical mechanics by Ginibre. As a consequence, the Euclidean Green's functions can for this model be obtained by a limiting process, with temperature and density going to infinity, from the reduced density matrices of a nonrelativistic Bose gas. Reduced functionals are defined and their equations determined as a preparatory step to renormalization in the super-renormalizable cases of two and three dimensions. (auth)

19556 INDEFINITE METRIC RESULTING FROM REGULARIZATION IN THE INFRARED REGION. Dubin, Daniel A.; Tarski, Jan. (New York Univ., N. Y.). J. Math. Phys., 7: 574-7(Mar. 1966).

The free scalar massless field is considered in two dimensions, defined with the help of Wightman's regularization at p = 0. The one-particle sector of this field is completed, and is shown to be a space of type II_1, studied by Iohvidov and Krein. Alternately, a direct sum of two such spaces can also be obtained. (auth)

19557 FUNCTIONAL FORMULATION OF THE LEE MODEL. Fried, H. M. (Brown Univ., Providence). J. Math. Phys., 7: 583(Mar. 1966). (NYO-2262-89).

The Lee model is defined as a particular member of a class of approximations to a relativistic, local, nontrivial field theory. Functional methods are applied to obtain generalizations of familiar properties, and to suggest variants of the model. (auth)

19558 ELEMENTARY PARTICLES IN FINITE SPACE. Yahya, Q. A. M. M. (Univ., Dacca, Pakistan). J. Natur. Sci. Math., 5: 187-90(Oct. 1965).

The concept that configurational space of field theory consist of a finite number of points is examined in further details. The way in which fields of spin 0, ½ and 1 would arise in this theory is shown and the form of the action principle is also discussed. (auth)

19559 QUASI-BORN TREATMENT OF THE SQUARE-WELL POTENTIAL. Gastmans, R. (Univ. of Louvain, Belg.). Nucl. Phys., 79: 593-603(1966).

After a brief outline of Weinberg's quasi-Born method, the bound state energies, scattering lengths and cross sections were calculated for the square well potential and compared with the exact results. It is then shown how wave functions can be calculated by this method. Finally it is shown how this could be applied to the distorted wave method. (auth)

19560 UNITARY SYMMETRY AND FINITE GROUPS. Cerulus, F.; Weyers, J. (Univ. of Louvain, Belg.). Nucl. Phys., 79: 604-8(1966).

A model was previously constructed showing that invariance under all permutations of three "chaos" fields and a Fermi type hamiltonian for the "physical" fields lead to a U(2) invariant theory, if there are in addition enough additive conservation laws. This model was generalized by Schechter et al., who have shown, without any restriction on the interaction, that two additive conservation laws and permutation invariance yield generally U(3) invariance. In this last result it is shown that one additive conservation law, permutation and "I invariance" lead to a U(3) invariant theory. Furthermore the case of four fundamental fields, is briefly investigated. (auth)

19561 ON A MASS FORMULA WITHOUT SYMMETRY BREAKING FOR SU(n). Formanek, J. (Faculty of Technical and Nuclear Physics, Prague). Nucl. Phys., 79: 645-51(1966).

A Lie algebra containing the Poincaré algebra and the intrinsic symmetry algebra SU(n) is constructed. A mass formula for a given type of representations of the algebra is obtained. The parameters in this formula for different irreducible representations are interconnected. The sign of the isospin splitting in the baryon decuplet is predicted to be the same as in the baryon octet. (auth)

19562 ON A COUPLING OF SPIN AND INTRINSIC SYMMETRY IN INFINITE-DIMENSIONAL LIE ALGEBRAS. Formanek, J. (Faculty of Technical and Nuclear Physics, Prague). Nucl. Phys., 79: 652-6(1966).

A Lie algebra containing the Poincaré algebra and the intrinsic symmetry algebra SU(n) is generalized to contain a coupling among spin and intrinsic degree of freedom. A class of representations of the generalized algebra is found and the corresponding mass formula is obtained without symmetry breaking. (auth)

19563 ON THE PHYSICAL IMPLICATIONS OF GAUGE INVARIANCE. Strocchi, F. (Lab. de Physique Theorique et Haustes Energies, Orsay, France). Nuovo Cimento (10), 42A: 9-12(1966).

Gauge invariance of the equations of motion is analyzed along the pattern of Noether's theorem and the physical implications of this invariance property are derived. They are not so strong as usually stated. (auth)

19564 SU_3 SYMMETRY IN A BOOTSTRAP MODEL. Roy, T. (Jadavpur Univ., Calcutta); Ghose, P. Nuovo Cimento (10), 42A: 13-16(1966).

Cutkosky has shown that if N vector mesons bootstrap themselves, symmetry under a compact semi-simple Lie group emerges as a natural consequence of bootstrap dynamics. However, he has imposed the restriction of equal masses for the N vector mesons. The work of Abers, Zachariasen, and Zemach on the pion-nucleon bootstrap has been generalized to the case of the vector meson octet to remove the restriction on degenerate masses for N = 8. (auth)

19565 AN ASYMPTOTIC EXPANSION FOR THE GREEN'S FUNCTION OF NONRELATIVISTIC POTENTIAL-SCATTERING THEORY AND THE ASYMPTOTIC CHARACTER OF THE BORN SERIES FOR THE JOST FUNCTION FOR LARGE COMPLEX ANGULAR MOMENTA. Brander, O. (Inst. of Theoretical Physics, Goteborg). Nuovo Cimento (10), 42A: 39-66(1966).

From a generalization of the Langer uniform asymptotic formula for Bessel functions of large order, an asymptotic expansion is constructed for the scattering Green's function. From this expansion a simple uniform bound for the Green's function follows, which contains the well-known nonuniform 1/k bound. This uniform bound is then used to study the asymptotic properties for large complex angular momenta of the Born series for the Jost function in nonrelativistic potential scattering theory for a great number of potentials. Among other things the following result is obtained. If the potential has a meromorphic continuation with a finite number of complex poles, into the half-plane Re r > 0 satisfying the condition $\int_u^a |rV(r)\,dr| < \infty$, $\int_a^\infty |V(r)\,dr| < \infty$, $0 < a < \infty$, on all rays in this half-plane, then the Born series for the Jost function is an asymptotic series in the Erdélyi sense and the Jost function tends to 1 when $|\lambda| \to \infty$ in any direction in the region $|\arg \lambda| \leq \pi/2$. Thus the Sommerfeld-Watson transformation is allowed for such potentials. For parallels to the imaginary r-axis the above condition may be slightly relaxed to include, for instance, the Yukawa potential. The method also gives some information about the necessary conditions to be imposed on the potential in order to make the Sommerfeld-Watson transformation permissible. Although strict mathematical proof is lacking, the following conclusions have been reached. The potential must have a smooth connection between small and large values of r, and it must not decrease faster than exponentially when $r \to \infty$, in order to make the Sommerfeld-Watson transformation permissible. (auth)

19566 INELASTICITY AND THE ONE-CHANNEL N-OVER-D METHOD. Squires, E. J.; Watson, P. J. S. (Univ. of Durham, Eng.). Nuovo Cimento (10), 42A: 77-86(1966).

The circumstances in which the one-channel N-over-D method gives results which agree with a many-channel calculation are examined. Numerical results for two similar cases are presented to illustrate the general results. The relation of these results with other recent work relevant to the same problem is discussed. (auth)

19567 ANALYSIS OF A PROPOSED ANALYTICITY TEST. Campbell, G. H. (Univ. of California, Berkeley). Nuovo Cimento (10), 42A: 126-36(1966).

An analyticity test proposed by Regge and Viano was analyzed under conditions similar to possible applications of the test to experimental data. It was shown that any results of such an application must be inconclusive. The class of functions to which this procedure may be applied was determined. This class may be broadened if partial knowledge of the asymptotic behavior of the functions is available. (auth)

19568 ELECTROMAGNETIC INTERACTIONS IN $\tilde{U}_{12}$ SYMMETRY. Renner, B. (Univ. of Cambridge, Eng.). Nuovo Cimento (10), 42A: 137-47(1966).

A model is developed for electromagnetic interactions of baryons and mesons in $\tilde{U}_{12}$ symmetry along the lines which led Salam to the deduction of the nucleon magnetic moments. The main assumption is vector meson dominance. A modification of Salam's treatment allows to deduce $\mu_p \simeq 1.7$ and $\mu_n \simeq -1.8$ nuclear magnetons (expt. $\mu_p \simeq 1.79$, $\mu_n \simeq -1.91$) for the nucleon magnetic moments. Consistency of the model requires the existence of only one independent strong-interaction coupling constant and leads to a relation between baryon-baryon-meson and three-meson coupling constant, which is found valid up to a factor 1.2, tested at $g_{NN\pi}$ and $g_{\rho\pi\pi}$. As independent test the model allows the deduction of about 0.72 Mev partial decay width for $\omega \to \pi^0 + \gamma$ (expt. (0.9 ± 0.2) Mev) and of $0.8 \cdot 10^{-16}$ s for the lifetime of $\pi^0 \to 2\gamma$ (expt. $(1.05 \pm 0.2) \cdot 10^{-16}$ s). (auth)

19569 AN UPPER BOUND ON THE COUPLING CONSTANT OF SCALAR MESONS. Mueller, V. F. (CERN, Geneva). Nuovo Cimento (10), 42A: 185-9(1966).

Assuming the scattering amplitude of scalar neutral mesons to be crossing symmetric and to have a certain amount of analyticity, then unitarity leads to an upper bound on the coupling constant for three scalar neutral mesons. (auth)

19570 ON THE ENERGY SPECTRUM OF de SITTER WORLD THEORIES. Roman, P.; Aghassi, J. J. (Boston Univ.). Nuovo Cimento (10), 42A: 193-7(1966).

The two diverging viewpoints on the energy spectrum were reconciled, by reformulating the unitarity condition in the L_5 group. The procedure of diagonalizing operators which generate noncompact groups (without changing the signature, but interchanging submanifolds of the same space) was used. (M.H.R.)

19571 CLASSIFICATION OF ELEMENTARY PARTICLES AND THE HYPOTHETICAL QUARK PARTICLE. Duerr, H. P. (MPI fuer Physik und Astrophysik, Munich). Phys. Bl., 21: 406-20(Sept. 1965). (In German).

The well-known relations existing between the quantum numbers of electron eigenstates of atoms are indicated. The discussion is limited to a consideration of the rotational symmetry. The isotopic spin of the elementary particles and the strangeness of hypercharge are described. A comparison is made between the formal SU_3 scheme and the experimental elementary particle spectrum. Mass formulas are given for the elementary particles under the assumption of a given symmetry perturbation. The fundamental significance of SU_3 is discussed. The quarks introduced by Gell-Mann are also considered. (J.S.R.)

19572 $\omega\varphi$ MASS SPLITTING, COLLINEAR U(6) SYMMETRY; AND ELECTROMAGNETIC FORM FACTORS. Oehme, R. (Univ. of Chicago). Phys. Lett., 20: 430-2 (Mar. 1, 1966).

In the limit of collinear U(6) symmetry, the electromagnetic form factors of baryons do not depend upon the separate singlet vector meson coupling which is characteristic for this symmetry. Introducing $\omega\varphi$ mass-splitting in the pole terms of the form factors, one can relate this coupling directly to the electric form factor of the neutron. It is shown that the experimental information about the electromagnetic form factors does not require a special supression of the separate single coupling. (auth)

19573 THE HIGH ENERGY APPROXIMATION AND SLIGHTLY NONLOCAL POTENTIALS. Reading, J. F. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Lett., 20: 518-21(Mar. 15, 1966). (MIT-2098-218).

The high energy approximation is extended to non-local potentials. Applied to the high energy optical potential a rough estimate indicates the removal of a large discrepancy between theory and experiment in the imaginary part of the potential. (auth)

19574 PARTIALLY CONSERVED AXIAL CURRENT AND THE PARITY-CONSERVING NON-LEPTONIC DECAYS OF HYPERONS. Badier, S.; Bouchiat, C. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett., 20: 529-31(Mar. 15, 1966).

As a consequence of the partially conserved axial current hypothesis, the P-wave hyperon decay amplitudes into zero mass virtual pions are shown to reduce to the baryon pole terms, in the limit of SU_3 symmetry. This result is in agreement with experiment. (auth)

19575 IMPLICATIONS OF I^2 AND I_3 CONSERVATION. Kroll, N. M. (CERN, Geneva). Phys. Lett., 20: 531-3 (Mar. 15, 1966).

It is shown, under very general assumptions, that an S matrix which commutes with I^2 and I_3 commutes with I_1 and I_2 as well. Observation of recently considered G violation would imply that observed I^2, I_3 conservation cannot be attributed to a hamiltonian conservation law. (auth)

19576 NON-LEPTONIC DECAYS IN A QUARK MODEL. Gaillard, M. K. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett., 20: 533-5(Mar. 15, 1966).

Some features are pointed out of a model for nonleptonic interactions based on the idea that baryons and mesons are compound states of elementary quarks. Remarks concerning the parity violating part of the hamiltonian belonging to the SU_3 octet are given, and the parity-violating decay amplitudes for baryons are calculated. (L.B.S.)

19577 ON THE SUPPRESSION OF STRANGENESS-CHANGING WEAK CURRENTS. Ambegaokar, V. (Cornell Univ., Ithaca, N. Y.); Tarjanne, P. Phys. Lett., 20: 535-7(Mar. 15, 1966).

It is shown that the $SU(3)_R \times SU(3)_L$ algebra, independently of the quark representation, does not seem consistent with the idea that small SU(3) violations lead to large changes in the vector and axial vector form factors for leptonic decays. (auth)

19578 A POSSIBLE MECHANISM OF CP VIOLATION. Arbuzov, B. A.; Filippov, A. T. (Joint Institute for Nuclear Research, Dubna, USSR). Phys. Lett., 20: 537-8 (Mar. 15, 1966).

The mechanism of CP-violation in interaction of particles with photons with the coupling constant Ge is considered. Possible experiments are discussed, which serve to check this mechanism. (auth)

19579 SU(6) PREDICTIONS FROM ADLER-WEISBERGER SUM RULES AND THE JOHNSON-TREIMAN RELATIONS. Schnitzer, H. J. (Brandeis Univ., Waltham, Mass.). Phys. Lett., 20: 539-41(Mar. 15, 1966).

Adler-Weisberger sum rules obtained from U(3) × U(3) are approximated by the decuplet for the low-energy scattering while the high-energy continuum is taken to satisfy the Johnson-Treiman relations. This leads to the SU(6) prediction for the meson-baryon d/f ratio and a sum rule for the decuplet contribution. (auth)

19580 DOUBLE LOGARITHMIC ASYMPTOTICS OF THE HIGH-ENERGY COMPTON SCATTERING. Frolov, G. V.; Gorshkov, V. G.; Gribov, V. N. (Ioffe Physical Technical Inst., Leningrad). Phys. Lett., 20: 544-6 (Mar. 15, 1966).

The double logarithmic asymptotics of the backward Compton scattering amplitude is found by means of the direct calculation of Feynman diagrams. The differential

cross sections are evaluated under various experimental conditions. (auth)

19581 CAN $\vec{I}^2$ BE CONSERVED, BUT NOT $\vec{I}$? Coleman, Sidney (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 539(Mar. 21, 1966).

It is proved that in relativistic local field theory if $\vec{I}^2$ is conserved all the components of the isotopic spin, $\vec{I}$, are conserved also. (G.O.Y.)

19582 COMMENT ON THE APPLICATION OF CUTKOSKY'S RULES. Rolnick, William B. (Case Inst. of Tech., Cleveland). Phys. Rev. Lett., 16: 544-5(Mar. 21, 1966).

An error in a previous application of Cutkosky's method of calculating the discontinuity of any Feynman integral is noted and is corrected. (D.C.W.)

19583 SPACE INVERSION, TIME REVERSAL AND PARTICLE-ANTIPARTICLE CONJUGATION. Lee, T. D. Phys. Today, 19: 23-31(Mar. 1966).

Concepts of discrete symmetry operations are reviewed. Space-inversion and time-reversal in classical physics, nonconservation of parity, particle identity, time-reversal invariance, and the CPT theorem are considered. Also the two-meson (π) decay of neutral mesons (K) and charge conjugation are discussed. (J.F.P.)

19584 A DERIVATION OF BOLTZMANN'S EQUATION WITH AN ASSUMPTION OF DETERMINACY. II. Ludwig, G.; Mueller, W. J. C.; Schroeter, J. (Univ. Marburg, Ger.). Physica, 31: 1649-72(Nov. 1965).

The fundamental steps of the new derivation of Boltzmann's equation with the assumption of determinacy were given previously. This derivation starts from Boltzmann's original interpretation of the function f(r,v,t) as a particle number density of one single system, and not as a probability density of an ensemble of systems. The two essential assumptions were formulated, the assumption of a stochastic process (assumption M), and the assumption of determinacy (assumption D), which imply that f(r,v,t) can be computed from $f(r,v,t-\tau)$ (and for instance not only if the whole earlier course in time is given), and that f(r,v,t) proceeds according to a deterministic law. For the formulation of these assumptions and of the initial assumptions a terminology of macroscopic description is used. In the present discussion the Boltzmann equation is derived explicitly, following that given previously. The explicit calculation of the integro-differential term $A_t(f(x,t))$, which is equal to the partial derivative $\partial f(r,v,t)/\partial t$ leads to the sum of the well-known collision and streaming terms of Boltzmann's equation. (auth)

19585 ON THE SOLUTION OF THE SEMICLASSICAL BOLTZMANN EQUATION. Lukes, T. (Northampton Coll. of Advanced Tech., London). Physica, 31: 1761-73 (Dec. 1965).

A Green's function solution of the semiclassical Boltzmann equation valid for time dependent inelastic scattering in the presence of an electric field is derived. Integro-differential and integral equations obeyed by the Green's functions are considered and it is shown that the Green's function may be expressed by means of a functional integral. Explicit results are obtained in certain cases by series expansions of the Green's function. For small angle scattering a partial differential equation for the Green's function is derived. (auth)

19586 ON SUBSTITUTION LAW. Ono, Ken-ichi (Tokyo Univ.). Sci. Pap. Coll. Gen. Educ., Univ. Tokyo, 15: 129-32(Dec. 1965).

The substitution law in S matrix theory is considered. An interpretation of the law is given, and its effects on the symmetry of the scattering amplitude are discussed. Theoretical factorization and shrinkage are also compared with experimental evidence. (J.F.P.)

19587 CRITICS ON THE INTERPRETATIONS OF ANTIPARTICLES. Ono, Ken-ichi (Tokyo Univ.). Sci. Pap. Coll. Gen. Educ., Univ. Tokyo, 15: 135-7(Dec. 1965).

Theories for the relations between particles and their antiparticles are discussed. It is suggested that the mirror particle interpretation be adopted. It follows from this interpretation that CP invariance becomes a self-evident law. But the substitution law must be checked particle by particle, since possible violations of this law depend solely on the internal structure of the particular particle. Thus elementary particles can be divided into classes of particles, those for which the substitution law holds and particles for which this law does not hold. The violation of CP invariance is considered a minor problem, since the galaxy is composed of matter rather than antimatter, causing particle-antiparticle symmetry to be perfectly broken. (J.F.P.)

19588 THE GENERALIZED REGGE REPRESENTATION OF THE SCATTERING AMPLITUDE. Yin, Pong-cheng; Chang, Chun-ting (Futan Univ., China). Wu Li Hsueh Pao, 21: 2004-14(Dec. 1965). (In Chinese).

The general form of the Regge representation of the scattering amplitude was established as $f(s,z) = i/2 \int_{-\frac{1}{2}-i\infty}^{-\frac{1}{2}+i\infty} [(2l+\mu+\nu+1)/\sin \pi l]\, f^{(\mu,\nu)}(l,s) P_l^{(\nu,\mu)}(-z)\, dl - \Sigma_i [\beta_i^{(\mu,\nu)}(s)/\sin \pi\alpha_i^{(\mu,\nu)}(s)]\, P_{\alpha_i^{(\mu,\nu)}}^{(\nu,\mu)}(-z)$, Re $\mu \geq -\frac{1}{2}$, Re $\nu \geq -\frac{1}{2}$, Re $(\mu+\nu) \geq 0$, where $P_l^{(\mu,\nu)}(z)$ is the Jacobi function. The relation between such a representation and the usual Regge representation was studied in detail. Some properties of the Jacobi functions are discussed. (auth)

19589 THEORY OF A NONLINEAR SPINOR FIELD. Mitter, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Z. Naturforsch., 20a: 1505-18(Nov. 1965). (In German).

The formal structure of a relativistic field theory is examined using functional techniques for Green's functions. The consequences of a locally conserved current constructed from a nonlocal bilinear covariant are studied. They result in a modified form of the Takahashi identities. Some problems are briefly discussed, which arise, if one tries to match conventional techniques as, e.g., the Bethe-Salpeter-method or the Schwinger-Fradkin formal solution with noncanonical quantization. The consistency of some approximation methods in relation to the aforementioned problems and to the existence of local currents is investigated. An expansion of the mass operator in powers of the interaction, using exact propagators, turns out to be consistent only with canonical quantization. For Tamm-Dancoff-like approximations the problem is more intricate. (auth)

19590 PREDICTIONS FOR THE WEAK LEPTONIC BARYON FORM FACTORS FROM THE HYBRID GROUP $SU_3 \otimes SU_3 \otimes U_1$. Schuelke, Lothar (Univ., Heidelberg). Z. Phys., 191: 209-16(Feb. 1966).

Relations between the form factors of the weak leptonic baryon interaction are obtained from invariance under the group $SU_3 \otimes Su_3 \otimes U_1$. The weak interaction operator $V_\mu - A_\mu$ is assumed to behave like the corresponding components of representations 35 of SU_6 with different parities. The result is obtained that the well-known predictions of the static SU_6 theory, viz., pure F-coupling for the vector- and 3D + 2F-coupling for the axial-vector part, are only valid in the limit of vanishing momentum transfer. In the same limit the result $C_A/C_V = -\frac{5}{3}$ is obtained if it is further assumed that V_0 and A belong to the same representation 35 of SU_6. (auth)

19591 SYMMETRY GROUPS IN NUCLEAR AND PARTICLE PHYSICS. A Lecture-Note and Reprint Volume. Dyson, Freeman J. The Mathematical Physics Monograph Series. New York, W. A. Benjamin, Inc., 1966. 330p. $9.00 (Cloth); $4.95 (Paperback).

A collection of three lectures and 32 reprints dealing with the application of group theory to nuclear and particle physics is presented. (D.C.W.)

19592 STRONG INTERACTIONS AND HIGH ENERGY PHYSICS. Scottish Universities' Summer School, 1963. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964. 491p.

Separate abstracts were prepared for the ten sections of the book. (G.O.Y.)

For abstracts of individual sections see: 19522, 19523, and 19593–19600.

19593 AN INTRODUCTION TO RELATIVISTIC S MATRIX THEORY. Squires, Euan J. (Univ. of Edinburgh). pp 1-80 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

An introduction to relativistic S-matrix theory is presented in which the Mandelstam representation in potential scattering, the partial-wave scattering amplitudes, the various singularities in the S-matrix theory, and some examples and dynamical calculations are discussed in detail. 94 references. (G.O.Y.)

19594 THE FRAMEWORK OF S MATRIX THEORY. Barut, A. O. (Univ. of Colorado, Boulder). pp 81-103 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

Helicity amplitudes, antiparticles, crossing symmetry, the CPT theorem, and related questions are discussed in terms of the S-matrix. The formulation of gauge invariance, V-A theory, and unitary symmetry is given in the same formalism; and analytic continuation is treated. (D.C.W.)

19595 SOME RIGOROUS CONSEQUENCES OF UNITARITY AND ANALYTICITY OF SCATTERING AMPLITUDES. Martin, A. (CERN, Geneva). pp 105-28 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

Asymptotic bounds on scattering amplitudes are derived using both strong and weak analyticity assumptions. The Mandelstam representation and unitarity are considered in detail. (D.C.W.)

19596 COMPLEX ANGULAR MOMENTUM IN ELEMENTARY PARTICLE SCATTERING. Oehme, Reinhard (Univ. of Chicago). pp 129-222 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

The high-energy behavior of scattering amplitudes is discussed together with singularities in the complex angular momentum plane. It is shown that particles with higher spin values must be described by Regge poles. The possible Reggeization of single-particle poles in renormalizable perturbation theory is also considered. (75 references). (D.C.W.)

19597 PHENOMENOLOGY BASED ON REGGE POLES. Udgaonkar, B. M. (Tata Inst. of Fundamental Research, Bombay. Argonne National Lab., Ill.). pp 223-58 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

Some of the applications of the Regge-pole concept in high-energy physics are reviewed. (59 references). (G.O.Y.)

19598 MULTIPERIPHERAL MODEL FOR HIGH ENERGY INTERACTIONS. Fubini, S. (Univ., Padua). pp 259-80 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

An attempt to achieve a unified treatment of the different high-energy processes on the basis of a field-theoretical model for the production amplitudes is discussed. (G.O.Y.)

19599 DETERMINANTAL APPROACH TO MULTICHANNEL SCATTERING. Blankenbecler, R. (Princeton Univ., N. J.). pp 411-36 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

It is shown that if the Fredholm determinant is known as an analytic function of one variable, the energy, it is possible to give algebraic definitions of the elements of the scattering matrix. The definitions given guarantee the unitarity and symmetry of the scattering matrix. It is also shown that the determinant has only the physical cuts in the energy even if there are anomalous or complex singularities in the elements of the scattering matrix. (G.O.Y.)

19600 THREE-PARTICLE SYSTEMS AND UNSTABLE PARTICLES. Lovelace, C. (Imperial Coll. of Science and Tech., London). pp 437-75 of Strong Interactions and High Energy Physics. Moorhouse, R. G. (ed.). New York, Plenum Press, 1964.

A theory of three-particle systems is presented. Only nonrelativistic particles interacting through generalized Yukawa potentials are considered. (D.C.W.)

19601 TESTS OF TIME REVERSAL INVARIANCE. Feinberg, G. (Columbia Univ., New York). 7p. (CONF-651001-18). ORAU. Gmelin, AED-CONF-65-293-3.

From IEEE Nuclear Science Symposium, San Francisco.

The general principles of testing T invariance are outlined, and a number of different tests are discussed in detail. (D.C.W.)

19602 ARE QUANTUM EFFECTS DUE TO GRAVITY? Arenberg, David L. (Arenberg Ultrasonic Lab., Inc., Jamaica Plain, Mass.). 47p. (CONF-651051-3). ORAU. Gmelin, AED-CONF-65-280-4.

From American Physical Society, New England Section, Fall Meeting, Orono, Me.

A study is made of the possibility that the nonradiating states of matter can be explained in terms of restraint of the motion of the associated radiation, not the motion of the electrons. A simple Rutherford model atom is set up in which the inward gravitational attraction of the nucleus for the relativistic mass of the radiation fields balances the outward gradient of the Poynting vector. (D.C.W.)

19603 OXFORD INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES, 19–25 SEPTEMBER 1965, PROCEEDINGS. Chilton, Eng., The Rutherford High Energy Laboratory, 1966. 253p. (CONF-650945).

Separate abstracts were prepared for 13 of the 14 papers included. The remaining paper is a brief discussion of the proposed European 300-Bev accelerator. (D.C.W.)

For abstracts of individual papers see: 19480, 19529–19531, and 19604–19612.

19604 BROKEN SYMMETRIES. Kibble, T. W. B. (Imperial Coll. of Science and Tech., London). pp 19-25 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

Some general features of relativistic broken-symmetry theories are discussed. (D.C.W.)

19605 ANALYTICITY IN AXIOMATIC FIELD THEORY. Glaser, V. (CERN, Geneva). pp 27-30 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

Analyticity is discussed considering only the LSZ field theory, the Wightman theory, and the local-ring theory of Araki and Haag. (D.C.W.)

19606 S-MATRIX THEORY. Landshoff, P. V. (Cambridge Univ., Eng.). pp 31-5 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The basic concepts of S-matrix theory are outlined, and poles and singularities in the physical region are briefly discussed along with other singularities. (D.C.W.)

19607 BOOTSTRAP MECHANISMS. Cutkosky, R. E. (Carnegie Inst. of Tech., Pittsburgh). pp 39-45 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

Various methods that are used to formulate self-consistent models for the bootstrap theory are discussed, and some models are analyzed. (G.O.Y.)

19608 CP VIOLATION. Prentki, J. (CERN, Geneva). pp 47-58 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

Some of the models that have been proposed in order to explain CP violation are discussed. The experimental implications of the various models are summarized. (D.C.W.)

19609 STRONG INTERACTIONS AT HIGH ENERGY. Lindenbaum, S. J. (Brookhaven National Lab., Long Island, N. Y.). pp 93-127 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

A review on the interpretation of strong interactions at high energies is presented. Experimental observations are compared with theoretical predictions, including dynamical predictions of symmetry theories. 86 references. (D.C.W.)

19610 APPROXIMATE SYMMETRIES IN STRONG INTERACTIONS. Gell-Mann, M. (California Inst. of Tech., Pasadena). pp 183-92 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The possibility of a compact group containing positive parity generators is discussed first. Possible higher symmetries are then considered; the possibility of negative parity generators is discussed, together with non-compact groups. (D.C.W.)

19611 WEAK INTERACTIONS AND QUESTIONS OF C, P, T NON-INVARIANCES. Lee, T. D. (Columbia Univ., New York). pp 225-39 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The status of weak interactions is reviewed; and some recent theoretical speculations about C,P,T non-invariances are discussed. (G.O.Y.)

19612 THE ROLE OF SYMMETRY PHYSICS/SOME CONCLUSIONS FROM THE CONFERENCE. Salam, Abdus (Imperial Coll. of Science and Tech., London. International Centre for Theoretical. Physics, Trieste, Italy). pp 241-53 of Oxford International Conference on Elementary Particles, 19–25 September 1965, Proceedings. Chilton, Eng., The Rutherford High Energy Lab., 1966.

The limitations of the symmetry method are outlined. (D.C.W.)

Fluid Physics and Thermodynamics

See also Plasma Physics and Thermonuclear Processes

Refer also to abstracts 18868, 19760, and 20116.

19613 (N-65-17282) THE SURFACE TENSION OF HYDROGEN. Stewart, R. B.; Germann, F. E. E.; McCarty, R. D. (National Bureau of Standards, Boulder, Colo.). Oct. 1, 1962. 14p. (NASA-CR-50286; NBS-7616). CFSTI $1.00 cy, $0.50 mn.

Some preliminary values are presented for the surface tension of normal hydrogen and parahydrogen from 14 to 33°K. (D.C.W.)

19614 (N-65-17283) THERMAL CONDUCTIVITY OF TEN CRYOGENIC LIQUIDS—A BIBLIOGRAPHY. Hall, L. A. (National Bureau of Standards, Boulder, Colo.). Apr. 15, 1963. 21p. (NASA-CR-50292; NBS-7684). CFSTI $1.00 cy, $0.50 mn.

References (73) are given for literature on the thermal conductivity of ^{3}He, ^{4}He, hydrogen, parahydrogen, deuterium, Ne, air, fluorine, oxygen, nitrogen, Ar, CO, and methane. An author index is included. (D.C.W.)

19615 (N-65-19888) TRANSPORT PROPERTIES OF A TURBULENT LORENTZ GAS [Thesis]. Technical Report No. A-33. Frank, Eugene N. (Case Inst. of Tech., Cleveland, Ohio. Dept. of Physics). Jan. 1965. 171p. (NASA-CR-57433). CFSTI $5.00 cy, $1.00 mn.

The fields of a turbulent Lorentz gas with an average magnetic field are expressed in terms of fluctuating quantities. The equations of conservation of momentum and matter are used along with Maxwell's equations to obtain a Fourier-analyzed momentum equation in terms of the fluctuating velocities alone. Nonlinear terms are linearized through the use of a dynamic viscosity-like term after Heisenberg. The study is then restricted to a semi-compressible plasma. It is found that in general six modes of wave motion are possible; three are modified classical modes and the others are mixed or turbulent modes which express the cross correlation between the classical modes present in the turbulence. Numerical results are obtained for the indices of refraction and the mobilities for the various modes. One of the most important results of the analysis is the appearance of an enhanced diffusion above a certain critical value of the magnetic field. (STAR)

19616 (N-65-27121) ON THE GROUND STATE OF LIQUID AND SOLID He-4 AT ZERO TEMPERATURE. Levesque, Dominique; Schiff, Daniel; Khiet, Tu; Verlet, Loup (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). June 1965. 24p. (TH-99).

A variational calculation is made of the ground-state energy of a system of ^{4}He atoms interacting by a Lennard-Jones potential at absolute zero and in a range of densities covering both the liquid and the solid region. (STAR)

19617 (N-65-27393) TWO-STEP PROCESS TO INCREASE ATOMIC HYDROGEN ION PRODUCTION IN LOW-PRESSURE RADIOFREQUENCY DISCHARGE. Prok, George M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1965. 15p. (NASA-TN-D-2912). CFSTI $1.00 cy, $0.50 mn.

The production of atomic ions in a low-pressure hydrogen discharge was improved significantly by first dissociating the hydrogen molecules at high pressure using microwaves at a frequency of 2450 Mc. After expansion through an orifice to the low-pressure region, the partially dissociated hydrogen was then ionized by an r-f coil which was operated at a frequency of 14 Mc. The decay of atomic hydrogen in the low-pressure region was minimized by eliminating all catalytic surfaces. (D.C.W.)

19618 (SC-RR-65-369) AIR-BLAST YIELD SCALING IN REFRACTING ATMOSPHERES. Reed, Jack W. (Sandia Corp., Albuquerque, N. Mex.). July 1965. Contract AT(29-1)-789. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Different atmospheric blast propagations result from various refractive wave divergence rates and give different overpressure-distance decay rates. This results in yield-scaling factors which depend on the decay rate for a given weather situation. A derivation was made which allows yield-scaling exponent determination from an observation of blast overpressure from a known-yield check shot. Conversely, from check-shot microbarograph recordings at vulnerable cities, an estimate can be made of yield limitations necessary to avoid window damages under the same weather conditions. (auth)

19619 (UCRL-16635) RADIATION ABSORPTION PHENOMENA IN GASES [Thesis]. Bezzerides, Bandel (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 1, 1966. Contract W-7405-eng-48. 122p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Green's function techniques are used to develop a general theory of line broadening in gases. As an example, the impact theory of Baranger et al., is derived, including effects due to recoil of the emitting atom. The fundamental processes responsible for the detailed structure of the absorption line are exhibited with the aid of a generalized optical theorem for scattering from thermal systems. To the extent to which intuitive notions of scattering theory are applicable, it is possible to define partial absorption rates

corresponding to overall coherent scattering processes. In particular, the fluorescence and quenching of an atom excited by resonance radiation are defined precisely, and a simple formula is given for the branching ratio between these two de-excitation channels. (auth)

19620 INVESTIGATION OF THE DYNAMICS OF LIQUIDS BY MEANS OF NEUTRON AND γ RADIATION. Weinzierl, P.; Ujlaki, E. (Univ., Vienna). Acta Phys. Austr., 21: 218-24(1966). (In German).

The present state of the investigation of the dynamics of liquids is briefly summarized. It is shown that by utilization of Rayleigh scattering of recoilless emitted γ quanta on liquids significant improvements can be expected in the results. An apparatus is described which makes it possible to use the 46.5-kev line of ^{183}W for these experiments. (tr-auth)

19621 INTERATOMIC FORCES AND THE STRUCTURE OF LIQUIDS. Enderby, J. E.; March, N. H. (Univ., Sheffield, Eng.). Advance. Phys., 14: 453-77(Oct. 1965).

Evidence relating to the dependence of the properties of liquids on the detailed form of the interatomic forces is reviewed. Arguments which start from the simplest assumptions about classical fluids are discussed. These are: that the total potential energy of the fluid can be expressed as a sum of pair potentials between atoms or ions, and that away from the melting and critical points these potentials are largely temperature independent. Consideration is restricted to monatomic fluids where central forces may be assumed. Topics treated include the radial distribution function, the three-body and Ornstein-Zernike correlation functions, an empirical determination of the pair potential, asymptotic behavior of the direct correlation function and pair potential, and evidence for the existence of a sharp Fermi surface in liquid metals. Also included are alternative treatments of the pair potential from solid state, and higher-order and time-dependent correlation functions. (J.F.P.)

19622 KINETIC MODEL FOR A TWO-COMPONENT RELATIVISTIC GAS. Marle, Charles. (Institut Francais du Petrole, Rueil-Malmaison, France). Compt. Rend., Ser. A, 262: 100-3(Jan. 3, 1966). (In French).

The positive definite expression of the entropy source makes it possible to predict the form of the linear laws of thermal conduction, viscosity, and diffusion. A relativistic kinetic model confirms the form predicted. The Onsager relations are verified, using an appropriate selection of the model parameters. (tr-auth)

19623 SHOCK WAVES IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Lichnerowicz, Andre. Compt. Rend., Ser. A, 262: 153-7(Jan. 10, 1966). (In French).

A complete system of equations of shock by a relativistic thermodynamic fluid of infinite conductivity is derived without recourse to privileged reference marks. Contrary to the classical case, each shock wave that is an Alfven wave after the shock is an Alfven wave before the shock. (tr-auth)

19624 THE TWO-DIMENSIONAL NON-STATIONARY FLOW IN A PLASMA ACCELERATOR WITH PROGRESSIVE WAVES. Peyret, Roger (California Inst. of Tech., Pasadena). Compt. Rend., Ser. A, 262: 192-5(Jan. 17, 1966). (In French).

The two-dimensional nonstationary flow in a channel of a compressible, electrically conductive fluid under the action of a progressive magnetic field is studied. The solution, obtained by linearizing the problem, shows the effects of the height of the channel and the field velocity. This conclusion is compared to that found for the one-dimensional approximation. (tr-auth)

19625 EXPERIMENTAL STUDY OF THE EVOLUTION OF JETS CONFINED IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Moreau, Rene (Univ., Grenoble, France). Compt. Rend., Ser. A, 262: 304-7(Jan. 31, 1966). (In French).

A study was made on two types of confined jets, one with and the other without lateral flow. Experimental curves of the variation of the excess velocity on the axis are presented for various values of the applied magnetic field. In the second case (quasi-free jet) the current lines showing the stopping of the jet by the magnetic field are also presented. (tr-auth)

19626 EXPERIMENTAL STUDY OF THE AFFINITY OF THE EXCESS VELOCITY PROFILES IN JETS CONFINED IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD. Moreau, Rene (Univ., Grenoble, France). Compt. Rend., Ser. A, 262: 259-62(Jan. 24, 1966). (In French).

The reduced excess velocity profiles, recorded in two sections for various values of the confinement parameter and of the applied transverse field, confirm the affinity hypothesis which is the basis of the approximate theory developed previously. The velocities were measured using a stainless steel Pitot tube. (tr-auth)

19627 CLASSICAL APPROXIMATION OF SHOCK EQUATIONS OF RELATIVISTIC MAGNETOHYDRODYNAMICS. Lichnerowicz, Andre. Compt. Rend., Ser. A, 262: 263-5(Jan. 24, 1966). (In French).

Relations between the shock equations of relativistic magnetohydrodynamics and of classical magnetohydrodynamics are derived. The disagreement concerning the creator or destructor shocks is analyzed. (tr-auth)

19628 NONLINEAR ABSORPTION OF LIGHT BY NEUTRAL GASES. Chalmeton, Vincent; Papoular, Renaud (CEN, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 262: 117-19(Jan. 10, 1966). (In French).

A gas exposed to intense monochromatic radiation becomes luminous. The spectrum emitted has the aspect of a bremsstrahlung spectrum and yields information on the temperature attained by the gas. The power extracted from the incident beam is deduced from this. Under the experimental conditions given this power varies as the square of the incident power. The absorption can be attributed neither to free electrons nor to the photoelectric effect. (tr-auth)

19629 CURRENT CONVECTION OF THE POSITIVE COLUMN IN A MAGNETIC FIELD AT LOW PRESSURE. Vladimirov, V. V. Dokl. Akad. Nauk SSSR, 164: 775-7 (Oct. 1, 1965). (In Russian).

It was shown previously for the case of high-pressure positive columns that when the mean free path of the charged particles is much shorter than the dimensions of the system, a current convection may take place in which the collision of neutral and charged particles play an important role. In cases in which the mean free path and the Larmor radius of the ions are large ($l_i, l_e > a, r_{iH} > a$, whereby a designates the radius of the tube), an interesting modification of this convection may arise as a result of the inertia of the ions, in particular, transport processes in an ambipolar electric field. A previously derived dispersion equation was generalized for the case in which the electron current velocity is not zero. The ions are generated with a zero-velocity in the electron-induced ionization of neutral atoms. The kinetic equation of ions and electrons was derived from Langmuir's equation under consideration of the relatively weak magnetic field. It was found for both high and low currents that the oscillation frequency at the limits of stability agrees within an order of magnitude with the inverse time of escape of the ions on the tube walls in the ambipolar field. (TTT)

19630 ASYMPTOTIC BEHAVIOR OF CLASSICAL GREEN FUNCTIONS IN VISCOUS HYDRODYNAMIC APPROXIMATION. Sadovnikov, B. I. Dokl. Akad. Nauk SSSR, 164: 1024-7(Oct. 11, 1965). (In Russian).

A previously stated closed equation for the fundamental Green's function for elastic spheres was further developed on the basis of successive approximations, in order to obtain a hydrodynamic analog. In view of the fact that it is sufficient to use only an acoustical approximation in order to derive the asymptote of the Green's function, similar

steps were taken for the hydrodynamic equation. The zero denominators of the derived Green's functions determine the dispersion of acoustical excitations in the system; the attenuation coefficients are defined through the kinematic viscosity and thermal conductivity coefficients. The results may be conveniently extended to quantum systems. (TTT)

19631 THE STABILITY OF ATTACHED SHOCK WAVES IN MAGNETOGASDYNAMIC FLOW PAST A WEDGE. Pack, D. C.; Swan, G. W. (Univ., Strathclyde, Glasgow). J. Inst. Math. Appl., 1: 317-22(Dec. 1965).

The question of the physical significance of the new phenomena indicated by Cabannes' work on magnetogasdynamic flow past a wedge is considered from the point of view of the stability of the shock waves. Analytical and heuristic reasons are given suggesting that downstream-facing shocks are stable if the upstream flow is supersonic and unstable if it is subsonic, while upstream facing shocks are always to be considered unstable. (auth)

19632 THE MAGNETOGASDYNAMIC BOUNDARY LAYER ON A THERMALLY INSULATED FLAT PLATE. Ingham, D. B. (Univ. of Leeds, Eng.). J. Inst. Math. Appl., 1: 323-38(Dec. 1965).

The effect of compressibility on the flow in the boundary layer on a semi-infinite, thermally insulated flat plate placed at zero incidence to a uniform stream of electrically conducting gas, with an aligned magnetic field at large distances from the plate is examined. The discussion is limited to small values of the conductivity parameter $\epsilon = 4\pi\sigma_\infty\mu\nu_\infty$, and the Prandtl number is taken to be unity. The latter assumption permits a simplification of the analysis, and the former allows the dependence of the flow on the parameters $\beta = \mu H_\infty^2/4\pi\rho_\infty U_\infty^2$ and $M = U_\infty/c$ to be adequately illustrated without excessive computation. A series solution valid for small values of the conductivity parameter and for Mach numbers not too large is derived. Values of $\beta = 0.3$ and 0.5, $\epsilon = 0.01$ and 0.1 are considered and for those values the skin friction decreases with increasing Mach number, similar to the case when $\beta = 0$. The analysis suggests that for larger values of β the skin friction might even increase with the Mach number initially. This is certainly the case with the tangential component of the magnetic field, which for $\beta = 0.5$ exhibits a maximum at approximately unit Mach number. The reason for this behavior lies in the fact that, in view of the temperature changes taking place in the flow, the electric conductivity and thereby the local value of ϵ can change by more than an order of magnitude. This has the effect of giving results which are akin to those for arbitrary large ϵ in incompressible flow even though the value of ϵ based on the main stream gas properties remains low. (auth)

19633 POINT TRANSFORMATIONS AND THE HARD-SPHERE BOSE GAS. Eger, F. M.; Gross, E. P. (Brandeis Univ., Waltham, Mass.). J. Math. Phys., 7: 578-4(Mar. 1966).

The method of point transformations is used to provide a Hamiltonian for strongly interacting particles that is equivalent to the usual Hamiltonian. The new Hamiltonian is Hermitian, Fourier analyzable, velocity dependent, and free of the difficulties of pseudopotentials. The present work is restricted to the case that two-body encounters are dominant. The theory is expressed in the quantized wave formalism so that number-violating approximations can be applied. The well known results for the spectrum and ground-state energy of the dilute hard-sphere gas are then derived as an elementary application. (auth)

19634 RESPONSE OF MAGNETOFLUIDDYNAMIC TURBULENCE TO AN IMPOSED STRONG MAGNETIC FIELD IN THE PRESENCE OF THE HALL EFFECT. Ohji, Michio (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap., 21: 167-72(Jan. 1966).

The Hall current terms are introduced into the spectrum equations of homogeneous magneto-fluid dynamic turbulence on which a strong uniform magnetic field is imposed externally. A neutral fully-ionized gas of uniform properties is assumed and the compressibility effects as well as the nonlinear terms are neglected. The full tensor equations are combined to derive the associated scalar- and vector equations whose solutions are obtained for a simple special case. The Hall effect is thus shown to destroy the tendency to equipartition of turbulent energy between the mechanical and magnetic modes by reducing the net flow of energy from the one mode to the other. (auth)

19635 A VARIATIONAL PRINCIPLE FOR A ROTATING RELATIVISTIC FLUID. Boyer, R. H. (Univ. of Liverpool); Lindquist, R. W. Phys. Lett., 20: 504-6 (Mar. 15, 1966).

Requiring the total energy of a time-independent axially symmetric relativistic fluid to be stationary, keeping fixed the total angular momentum and baryon-number, it is found that the fluid must be isentropic and in uniform rotation. (auth)

19636 NONLINEAR MICROWAVE CONDUCTIVITY OF A SLIGHTLY IONIZED GAS FOR ARBITRARY COLLISION CROSS SECTIONS. Bloch, S. C. (Univ. of South Florida, Tampa). Phys. Rev., 144: 181-5(Apr. 8, 1966).

A tractable expression for the current density in a slightly ionized gas under the influence of an electromagnetic field is obtained for arbitrary velocity dependence of the electron–heavy-particle cross section for elastic collisions. The discussion is restricted to the case of a weak field in the high-frequency approximation (frequency of the field much greater than the average collision frequency) in an isotropic plasma. For the special cases of a constant mean free path and a mean free path inversely proportional to the square root of electron temperature, the current density obtained here agrees with results previously derived by Epstein. The effect of the nonlinearity is to increase the current density in phase with the applied field if the collision frequency increases with velocity, as with hard spheres; the nonlinearity decreases the in-phase component of the current density if the collision frequency decreases with velocity, as with screened Coulomb collisions. The case of constant collision frequency results in a linear current density. Simple applications to cross modulation by pulsed microwaves and frequency mixing are discussed. (auth)

19637 TURBULENT FLOW OF A CHARGED FLUID IN A NONCONDUCTING PLANE CHANNEL. Kopylov, G. N. (Aviation Coll., Leningrad). Zh. Tekh. Fiz., 35: 1337-48 (Aug. 1965). (In Russian).

A previous discussion of the laminar flow of a charged fluid in a plane nonconducting channel is generalized to the case of turbulent flow. The calculations are based on the Stokes-Navier equations with an additional term for the emf of the electric field on the fluid, Poisson's equation for the electric field, an equation for the electric current as the sum of convection, diffusion, and conduction currents, and the continuity equations for the fluid and the electric charge. These equations are averaged to give the equations for turbulent flow; the equations of motion are Reynolds' equations with additional terms for the electric force. The equations are specialized to the case of steady flow between infinite parallel nonconducting planes and are solved separately for the laminar boundary layers and the turbulent core. Prandtl's expression for the turbulent stress in terms of a mixing length is used, the mixing length is assumed to vary linearly with the distance from the wall, and the solution for the turbulent core is effected by an approximation method that depends on the electric field being small. It is found that the effect of the electric field is less in turbulent than in laminar flow, due to concentration of the charge in thin regions near the walls within the laminar boundary layers. Numerical calculations are carried out for the case of air. (TCO)

19638 ON THE THEORY OF THE DEVELOPMENT OF A SPARK DISCHARGE. I. Andreev, S. I.; Orlov, B. I. Zh. Tekh. Fiz., 35: 1411-18(Aug. 1965). (In Russian).

The current time variation and the spark-channel widening during the first half cycle of the discharge in a circuit containing capacity, inductance, and a spark gap are stud-

ied. The time dependence of the gap resistance is derived from the energy balance equation, assuming that all the power released in the gap is expended in widening the spark channel and not in heating the spark plasma, whose resistivity is thus assumed constant. It is also assumed that the rate of expansion of the spark channel is related to the pressure according to the equations of Braginskii and that the channel radius at the time of formation is given by the diffusion theory of streamer development. The time variations of the discharge current and the spark-channel radius are calculated numerically for various values of discharge potential, circuit capacitance, and inductance, and the results are found to be in good agreement with previous experimental data. (TCO)

19639 SUPERSONIC HYDROGEN JET IN A VACUUM. Yuferov, V. B.; Kovalenko, V. A.; Skibenko, E. I.; Busol, F. I. Zh. Tekh. Fiz., 35: 1522-3(Aug. 1965). (In Russian).

The production and study of supersonic hydrogen jets in vacuum are described. Problems arising due to the low heat of vaporization of the liquid helium used to remove the hydrogen are discussed. The pressure in the charge-exchange chamber was about 7×10^{-5} mm Hg for a hydrogen flow of 50 cm^3/sec. Improvement of the thermal insulation of the condenser is expected to enable lower pressures to be reached with the same flow speeds and thus to bring about development of the vacuum hydrogen jets to provide useful charge-exchange targets for producing high-energy neutral atomic beams for injection into thermonuclear devices. (M.J.T.)

Geophysics

19640 (N-65-21332) ADIABATIC MOTIONS OF CHARGED PARTICLES IN A DIPOLE MODEL OF THE MAGNETOSPHERE. Hones, Edward W. Jr. (State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy). Mar. 1965. 23p. (NASA-CR-57944). CFSTI $1.00 cy, $0.50 mn.

The use of the first and second adiabatic invariants of charged-particle motion in calculating the trajectories of particles drifting in combined magnetic and electric fields is discussed. Such calculations become particularly simple for a dipole magnetic field if the magnetic lines of force are electric equipotentials. (STAR)

19641 (N-65-21748) A COOPERATIVE REPORT ON THE CORRELATION BETWEEN AURORAL, MAGNETIC, AND ELF PHENOMENA AT BYRD STATION, ANTARCTICA. Helms, Ward J.; Turtle, John P. (Stanford Univ., Calif. Stanford Electronics Labs.). Aug. 1964. 42p. (SEL-64-043; TR-3408-2).

The results of a synoptic correlation study carried out at Byrd Station, Antarctica, during the austral winter of 1962 are given. The data cover the months of June, July, and August. Several independent data systems were used to continuously monitor the electromagnetic spectrum from 0.05 cps through 20 kc. Quantitative amplitude vs frequency records of the upper elf and vlf bands are shown. Synoptic auroral data were obtained from an all-sky camera, all-sky photometer, and narrow-beam photometer. Some regular slow-speed magnetograph data are also shown. The geophysical events recorded are seen to fall into two broad categories: the impulsive events near magnetic midnight, and the regular events near magnetic noon. Detailed relationships between phenomena during typical events of both types are shown. The magnetic-midnight events are seen to be very large amplitude, short-lived disturbances characterized by correlated auroral flareups, vlf hiss burst, and rapid magnetic-field variations. The magnetic-noon disturbances are of lesser intensity and longer duration, and are characterized by vlf chorus and regular-type magnetic micropulsations. No correlation between these phenomena is evident except for agreement between minute intensity pulsations in the aurora and magnetic micropulsations in the period preceding magnetic noon. No correlation was found between elf signals and other geophysical events at any time of day. (STAR)

19642 (N-65-23066) INTERPLANETARY MAGNETIC FIELD AND POLAR MAGNETIC DISTURBANCES. Fairfield, D. H.; Cahill, L. J. Jr. (New Hampshire Univ., Durham. Dept. of Physics). [1964]. 32p. (NASA-CR-62576). CFSTI $2.00 cy, $0.50 mn.

The Explorer 12 measurements of the magnetic field outside the magnetosphere are compared with magnetograms from Arctic observatories. The results indicate that an exterior field with a southerly component tends to be associated with ground disturbance, while a northward field is associated with quiet conditions. Examples are presented showing how a north-to-south field direction change accompanies an increase in ground activity, and also how south-to-north changes may produce quiet intervals between substorms. The results are discussed in terms of breaking and reconnection of the interplanetary field to the dipole field as the solar wind carries the variously directed interplanetary fields past the earth. (STAR)

19643 (N-65-23662) ELECTRON DENSITIES AND TEMPERATURES IN THE F REGION FROM BACKSCATTER MEASUREMENTS AT ARECIBO. Carlson, H. C.; Nisbet, J. S. (Pennsylvania State Univ., University Park). [1965]. 16p. (NASA-CR-62663). CFSTI $1.00 cy, $0.50 mn.

The diurnal variation in electron densities and temperatures in the F-region above Arecibo, Puerto Rico, is discussed. The morning buildup and nighttime decay of temperatures on several summer and winter days are presented as a function of height; and possible explanations are given for the seasonal differences. Up to 375 km the ion temperatures appeared to be in good agreement with estimates of the neutral-particle temperatures except for a period of several hours after sunrise when significant departures were observed in the region of 300 km. Electron temperatures were generally observed to be about three times the ion temperatures during the day and to have a rather irregular behavior from day to day. During the night, ratios of electron-to-ion temperatures in excess of 1.2 were observed at all times in the region of the F_{max}. (STAR)

19644 (N-65-23933) DIRECT DETECTION OF AMBIENT ELECTRON PLASMA OSCILLATION FIELDS IN THE MAGNETOSPHERE. APPENDIX D. Scarf, F. L.; Fredricks, R. W. (Space Technology Labs., Inc., Redondo Beach, Calif.). Mar. 1965. Contract NASw-698. 6p. (NASA-CR-62753; STL-8494-6007-SU-000(App.D)). CFSTI $1.00 cy, $0.50 mn.

Recently radio noise measurements were reported on 700 kc/sec and 2.2 Mc/sec at altitudes between 3,000 and 11,000 km from a high-altitude rocket probe. A relatively high background brightness at 700 kc/sec and several intense noise bursts were also observed. It was suggested previously that nonthermal source mechanisms such as harmonic gyro radiation and electromagnetic radiation from plasma waves could contribute to the high 700-kc/sec background, and radiation from relativistic electrons was considered as the source of one of the noise bursts which appeared on both channels near the geomagnetic equator. However, it was observed that the most intense noise burst appeared only on the lower channel and at an altitude for which the local electron plasma frequency approached 700 kc/sec. A possible interpretation of this event is discussed. It is suggested that the probe antennas were simply responding to the electrostatic fields associated with the thermal or equilibrium level of electron plasma oscillations, rather than to any local resonance. (STAR)

19645 (NASA-SP-97) SIGNIFICANT ACHIEVEMENTS IN PARTICLES AND FIELDS, 1958-1964. (National Aeronautics and Space Administration, Washington, D. C. Scientific and Technical Information Div.). 1966. 94p. GPO $0.50.

Information obtained during the past few years by both U.S. and U.S.S.R. satellites concerning the solar wind and its effect on the earth, radiation belts, the geomagnetic

field, solar energetic particles and ground effects, cosmic rays, and neutrons is discussed. (M.O.W.)

19646 (SC-DC-65-1701) THE DEVELOPMENT OF A DYNAMIC THREE-DIMENSIONAL ATMOSPHERIC MODEL FOR USE IN THE STUDY OF THE SELECTIVITY OF ORBITAL DECAY (TASK III). (Hittman Associates, Inc., Baltimore, Md.). July 1965. Contract AT(29-1)-789. 79p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

For Sandia Corp., Albuquerque, N. Mex.

A number of atmospheric models were evaluated for use in the study of the selectivity of orbital decay. It was found that only Anderson's model indicates the variation of density with latitude. A computer program MODEL was written to facilitate the use of this model. The program was used to calculate the density of the atmosphere as a function of several parameters for an altitude range of 90 to 800 km. 137 references. (D.C.W.)

19647 IONOSPHERE AND SOLAR ACTIVITY. Dieminger, Walter (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Arch. Elek. Uebertr., 19: 575-89(Nov. 1965). (In German).

Some correlations between sunspot activity and the intensity of ionizing radiations in the various ionosphere layers were examined on the basis of terrestrial and satellite measurements. The electron density in the different ionospheric layers increases with increasing solar activity. Attempts to derive the variation of the intensity of the ionizing radiation were successful for the E and F_1 layers but failed for the F_2 layer since the structure of this latter varies in a complicated manner with the solar activity. (TCO)

19648 TEMPERATURES OF IONS AND ELECTRONS IN THE IONOSPHERE. Willmore, A. P. (London Univ.). Endeavour, 25: 45-51(Jan. 1966).

Until relatively recently, it was impossible to measure the variations in the temperature and concentrations of ions in the upper part of the ionosphere — the layer of the atmosphere that reflects long-distance radio waves. The measurements that rocket-launched satellites have made possible have shown errors in the assumptions about this region. The ionospheric processes are discussed, and it is shown how they are connected with processes in the surrounding magnetosphere. (auth)

19649 SPORADIC E THEORY. I. COLLISION-GEOMAGNETIC EQUILIBRIUM. MacLeod, Malcolm A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Atmos. Sci., 23: 96-109(Jan. 1966).

A simple equilibrium theory of ionization transport in the ionosphere is described which predicts a tendency for thin layers of overdense ionization (sporadic E layers) to form in the E-region. Such layers can be produced by the dominance of any of five mechanisms of ionization convergence. Three of these mechanisms involve the neutral wind shear and two involve the neutral wind. The theory assumes that ambipolar diffusion of the electrons and heavy positive ions takes place under the influence of the forces due to neutral collisions and the geomagnetic field. The layer formation tendency is strongest for the principal part of the wind shear convergence mechanism in the lower E region at those altitudes where the neutral vorticity is antiparallel to the geomagnetic field, and in the upper E region where the neutral vorticity is perpendicular to the geomagnetic field in the westward (eastward) sense in the northern (southern) geomagnetic hemisphere. The layer formation tendency is strongest for the wind convergence mechanism in the middle E region. The altitudes of these layers may be predicted by constructing the equilibrium ion drift velocity convergence profile from the observed neutral wind profile. This is done for four experiments carried out in December, 1962, and close agreement is found between the predictions of the theory and the observed characteristics of four out of six sporadic E layers, providing convincing proof of the existence of a wind shear transport mechanism. (auth)

19650 THE VARIATION OF THE NEUTRAL ATMOSPHERIC PROPERTIES WITH LOCAL TIME AND SOLAR ACTIVITY FROM 100 TO 10,000 km. Anderson, Albert D.; Francis, William E. (Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Atmos. Sci., 23: 110-24(Jan. 1966).

A semi-theoretical model of the upper atmosphere was constructed to allow the calculation of neutral properties from 100 to 10,000 km as a function of local time and solar activity. The calculations are based on empirical density profiles obtained from a density (satellite-drag) model. Assuming diffusive equilibrium above 110 km and an isothermal region above 200 to 400 km, the remaining properties (pressure, temperature, molecular weight and constituent concentrations) are computed from a least squares procedure that, together with the hydrostatic equation and equation of state, determines individual particle concentrations. Some justification should be made for the introduction of a new model. The model greatly extends the altitude range covered by most models. In order to do this, it accounts for the variation in the rate of escape of hydrogen from the exosphere over a solar cycle. In addition, the model represents the diurnal variation of hydrogen in the exosphere, a factor previously neglected. The maximum variation in the atomic hydrogen concentration from 6000 to 10,000 km, due to both the solar activity and diurnal effects, is about a factor of four. The total variation in atomic helium is much greater; it varies by about five orders of magnitude. Finally, the diurnal and solar activity effects are enumerated in a consistent way from 100 to 200 km. Nine tables present the neutral atmospheric properties versus altitude for sunspot maximum, average, and minimum conditions and for local times of 5, 14 and 21 hr (or 8 hr). These tables provide a simple format for the diurnal and solar activity variation of the properties, especially their profiles, for comparison with other models and with measurements made from rockets and satellites. (auth)

19651 EXCHANGE OF ENERGY BETWEEN THE IONOSPHERE AND THE PROTONOSPHERE. Geisler, J. E.; Bowhill, S. A. (Univ. of Illinois, Urbana). J. Atmos. Terrest. Phys., 27: 1119-46(Nov.-Dec. 1965).

A theory of non-local heating of the topside ionosphere and the protonosphere by photoelectrons which escape the F2-layer is developed. Use is made of the expression for the rate of heat input to a protonospheric field tube to obtain an estimate of the rate at which thermal energy is conducted downward across the 1000 km surface at middle geomagnetic latitudes during the day. The expression for the rate of heat input is combined with the steady-state heat conduction equation to calculate the temperature distribution along the axis of the field tube. It is shown that, near sunspot maximum, heating by photoelectrons which escape the F2-layer produces a steep temperature gradient along a middle-latitude field tube; near sunspot minimum, however, the protonosphere is found to be very nearly isothermal in the region enclosed by the magnetic shell intersecting the 1000 km surface at 40° geomagnetic latitude. A time-dependent model describing the night-time cooling of a middle-latitude protonospheric field tube is presented. The model supports the conclusion that a downward flux of some 10^8 ev cm^{-2} sec^{-1} into the ionosphere can be maintained throughout most of the night. The electron temperature profile calculated for this heat flux is in good agreement with measurements of night-time electron temperature in the topside ionosphere, leading to the conclusion that a downward flux from the protonosphere is the only significant source of heat input to the quiet night-time ionosphere at middle latitudes. (auth)

19652 PLASMA DIFFUSION IN THE IONOSPHERE. II. Chandra, S. (National Physical Lab., New Delhi). J. Atmos. Terrest. Phys., 27: 1159-62(Nov.-Dec. 1965).

An equation of continuity is derived for the F-region without assuming ambipolar diffusion. It is shown that the commonly employed form of the equation of continuity remains unaltered if the divergence of electron and ion fluxes are equal. It is further shown that the so-called "diffusion term" in the equation of continuity implicitly includes the effect of electric field whatever be its origin. An expression for electric field is derived which is applicable to a

situation in which the plasma density and electric potential vary in the vertical direction only. (auth)

19653 DIFFUSION AND ELECTROMAGNETIC DRIFT IN THE EQUATORIAL F2-REGION. Bramley, E. N.; Peart, M. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys., 27: 1201-11(Nov.-Dec. 1965).

Calculations of the equilibrium electron density distribution in the F2 region of the equatorial ionosphere are described. The effects of photoionization, loss, diffusion along geomagnetic field lines, and an electromagnetic drift of arbitrary magnitude are included. The work is an extension of previous calculations in which the drift was included as a perturbation effect only. It is found that under representative daytime ionospheric conditions an upward drift of a few meters per second is sufficient to produce an equatorial anomaly which is quantitatively similar to that observed experimentally. (auth)

19654 HEIGHT VARIATIONS OF THE F2-LAYER ABOVE TSUMEB DURING GEOMAGNETIC BAY-DISTURBANCES. Ruester, R. (Max-Planck-Institut fuer Aeromonie, Lindau/Harz, Ger.). J. Atmos. Terrest. Phys., 27: 1229-45(Nov.-Dec. 1965).

For 4 bay-disturbances of the earth's magnetic field the respective true height variations of the F-layer above Tsumeb are deduced from ionograms taken at Tsumeb. It is found experimentally that these true height variations are mostly accompanied by a variation of the thickness of the whole layer. In order to interpret these vertical movements they are assumed to be caused by the horizontal electric field component of the current system underlying the observed magnetic bay-disturbance. The field itself is determined under fixed assumptions about the conductivity. The system of differential equations, that describes the motion of the charged particles in a neutral gas under the influence of a variable electric and a permanent magnetic field, is solved for a homogeneous plasma both numerically and by an analytic approximation. The comparison between the observed and the computed heights shows a qualitative agreement, but quantitatively the theoretical data exhibit a faster response of the F-layer than is observed. Possible sources of error are discussed in order to understand this difference. In particular, it is believed that the relation between the variations in the observed magnetic field strength at the ground and the effective electric field strength in the ionosphere is not linear, as it is assumed here. (auth)

19655 TRAVELLING DISTURBANCES ASSOCIATED WITH IONOSPHERIC STORMS. Bowman, G. G. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys., 27: 1247-61(Nov.-Dec. 1965).

Following each of three geomagnetic sudden commencements, ionospheric disturbances (ionospheric storms) are found to propagate from two isolated locations in high-latitude regions of the earth. These two positions are conjugate points (magnetically), and are in different locations for each magnetic storm. Speeds of travel are 361 m/sec and 722 m/sec. Disturbances with the slower speed produce detectable effects on the ionosphere after encircling the earth. I.G.Y. data (hourly values of h'F) from a world-wide station network were used and a superposed-epoch method employed. A study of ionograms from Australian stations during these and other magnetic storms supports the superposed-epoch results. It is shown that red arcs, certain auroral forms and vlf electromagnetic emissions may be associated with these travelling disturbances. (auth)

19656 POWER SERIES SOLUTION OF THE F2-LAYER DIFFUSION EQUATION. Baxter, R. G.; Kendall, P. C.; Windle, D. W. J. Atmos. Terrest. Phys., 27: 1263-73 (Nov.-Dec. 1965).

If the equatorial electron density profile in the region is known, the equilibrium electron density everywhere else can in theory be computed. A method is given for carrying out this process for regions within 30° of latitude of the dip equator for an exponential atmosphere of constant scale height and for symmetry about the dip equator. This is achieved by simplifying the diffusion equation for an isothermal atmosphere, then expanding in a power series, convergent at great height and whose coefficients are functions of latitude. The method is applied to a study of the distributions of electron density expected from an equatorial profile with a single maximum, similar to a Chapman profile. Attention is confined to the case of no production and loss, with an upward electrodynamic drift at right angles to the magnetic field lines and uniform at the dip equator. The results are of interest in connection with the electron density at great height in the F2-layer, and illuminate the nature of the diffusion equation. The electrodynamic drift causes the latitudinal peaks in electron density at constant height to move in towards the dip equator, and a concentration of ionization at low heights closer to the dip equator. It is suggested by analogy with a straight field line model that in fact the electron density becomes infinite at infinitely low heights in this region of concentration, corresponding to a distribution of sources there. Thus an equilibrium layer, in absence of production and loss must be supported from below. (auth)

19657 THE POLAR ELECTROJET. Akasofu, S.-I.; Chapman, S.; Meng, C.-I. (Univ. of Alaska, College). Contract NsG 201-62. J. Atmos. Terrest. Phys., 27: 1275-1305(Nov.-Dec. 1965).

It is shown that the polar electrojet which causes intense "negative bays" or polar magnetic substorms in the high latitudes, flows usually westward in all longitudes along a closed oval curve. This substorm oval is also the site along which at the instant the active aurora is situated. Further, it appears to be the line of intersection of the outer boundary of the outer radiation belt with the ionosphere. The center of the oval is appreciably displaced from the earth's magnetic axis pole, along the midnight meridian. The oval coincides approximately with the statistically determined auroral zone only in the midnight sector. The strength of the polar electrojet is not uniform along the substorm oval; some of the excess current in the most intense part of the electrojet (near the midnight meridian) returns across the polar cap, encircling a focus in this cap; the remainder departs from the afternoon sector and crosses the midnight meridian to complete its circuit by rejoining the main westward flow in the morning sector, with its focus in the midnight sector not far outside the oval. This latter flow produces positive bays everywhere south of the focus; these bays can be particularly intense in the afternoon sector along the auroral zone, and were formerly interpreted as indicating the existence of an eastward polar electrojet. The changing geometry of the polar electrojet is brought into relation with the dynamical morphology of the simultaneous auroral substorm, which was recently determined by study of simultaneous all-sky camera records from the entire polar region. (auth)

19658 ON THE IONOSPHERIC F2-REGION EQUATORIAL ANOMALY. Awojobi, O. A. J. Atmos. Terrest. Phys., 27: 1309-11(Nov.-Dec. 1965).

It is pointed out that the equatorial anomaly of the F2 region may not be directly connected with the earth's magnetic field. The noon meridian values of f_0F2 for March 1958, for the available IGY stations were plotted first against the geographic latitude and then against the magnetic dip. These data show a regular pattern. This leads to the conclusion that some of the anomalies that are usually associated with the earth's magnetic field can be explained by loss rates which are higher than those generally used. (J.F.P.)

19659 CORRELATIONS BETWEEN QUIET-DAY MAGNETIC RANGES. Osborne, Denis G. (Univ. Coll., Dar es Salaam, Tanganyika, Africa). J. Atmos. Terrest. Phys., 28: 45-51(Jan. 1966).

Correlation coefficients are given between values for daily ranges of the horizontal magnetic component at seven different latitudes. These show a coherence in the magnetic variation on quiet days that suggests an extraterrestrial cause for the variability from day to day of ionospheric electric currents. It is shown also that changes in the strength and latitude of the equatorial

electrojet over Peru are independent of changes in the strength and focus latitude of the quiet-day current system over the northern hemisphere. (auth)

19660 SPIRALLING ELECTRONS AND SUPERIMPOSED ELECTRIC FIELDS. Catchpoole, J. R. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys., 28: 75-85(Jan. 1966).

The superposition of a longitudinal electric field along the direction of the lines of force of the earth's magnetic field results in a change in the spiralling-mirroring domain of trapped electrons. The extent of this effect is determined as a function of the applied electric field, and of the equatorial plane ratio of longitudinal to transverse electron velocities. Under certain idealized conditions, the consequent relative increase is found of the injection of electrons from the magnetosphere into the ionosphere. (auth)

19661 OBSERVATIONS OF AURORAL ECHOES FOLLOWING WORLDWIDE STORM SUDDEN COMMENCEMENTS. Brooks, D. (P.E.L. Auroral Station, Omakau, N. Z.). J. Atmos. Terrest. Phys., 28: 103-9(Jan. 1966).

Data on the Northern Hemisphere radio aurora obtained on a 17 Mc radar located at Sheffield, England (56° geomagnetic latitude) had shown that the delay in onset of auroral echoes following a sudden commencement depended upon the local time of the occurrence of the S.C. A comparison is made between these results and the same events observed on a 55 Mc radar at Bluff, New Zealand (51.5°). The differences in behavior which appear are attributed to the effects of absorption on equipments with different parameters. (auth)

19662 NIGHT LOWER IONOSPHERE AT GEOMAGNETIC LATITUDE 40 DEG N AS INDICATOR OF CORPUSCULAR RADIATION PHENOMENA. Nestorov, G. (Geophysical Inst., Sofia); Krivsky, L.; Letfus, V. J. Atmos. Terrest. Phys., 28: 121-5(Jan. 1966).

It is shown that, during the ionospherically disturbed period 28 April–13 May 1960 the night-time reflection coefficient of a radio wave of frequency 155 kc traveling over a distance of 380 km was closely correlated with cosmic ray and solar phenomena. (auth)

19663 SOLAR FLARE EFFECTS ON F2 IONIZATION IN LOW LATITUDES. Kotadia, K. M. (Gujarat Univ., Ahmedabad, India). J. Atmos. Terrest. Phys., 28: 143-52(Feb. 1966).

The results of a study on the effects of solar flare radiation on the electron density of the F2-layer of the ionosphere at its level of maximum in and near the equatorial anomalous zone are presented. It is shown that a perceivably significant increase f_0F2 could be produced by daytime solar flares occurring at times when the sun's altitude is low; the effect is more marked in winter. In the light of this observation and previously published results it is possible to conclude that the solar flare-induced increase in the electron density of the F2 layer can be observed when hmF2 is low (300 km or below) and other factors such as tidal and electromagnetic drift forces are less active at the time of occurrence of the flare. It is further attempted to show that changes in f_0F2 that follow a solar flare have no connection with those produced by geomagnetic disturbances at low magnetic latitudes. (auth)

19664 CONTOUR MAPS OF THE GEOMAGNETIC DIURNAL VARIATION. Hall, S. H. (Imperial Coll. of Science and Tech., London). J. Atmos. Terrest. Phys., 28: 165-73(Feb. 1966).

A method is described for contouring the diurnal changes in the magnetic elements provided by published observatory tabulations of mean hourly values of mean monthly days. By projecting the position of the observatory onto a geocentric sphere which remains fixed in relation to the Sun, then throughout the course of a year a zone 47° wide is scanned by the observatory on the trajectories of which the diurnal changes of the elements can be inserted. On contouring the data, maps are produced illustrating the progressive seasonal and annual changes of the diurnal field as viewed from the Sun. Examples are given for Toolangi (H,Z) for the 5 yr preceding the I.G.Y. and for Macquarie Island and Heard Island (H,Z), 1953. (auth)

19665 ON THE EXTENSION OF AURORAL-ZONE X-RAY MICROBURSTS. Trefall, H.; Bjordal, J.; Ullaland, S. L.; Stadsnes, J. (Univ. of Bergen). J. Atmos. Terrest. Phys., 28: 225-33(Feb. 1966).

Simultaneous observations of auroral-zone x ray microbursts made by two balloon-borne radiation detectors at a separation of about 300 km are compared with previous observations of the same kind, and used to estimate the size of the region of electron precipitation in such events. As both balloons were at nearly the same geomagnetic latitude, only the E–W extension of microburst events could be deduced. This was found to be approximately 200 km, which corresponds to about 3500 km if projected along the magnetic lines of force to the geomagnetic equatorial plane. (auth)

19666 AMPLIFICATION OF HYDROMAGNETIC WAVES IN THE MAGNETOSPHERE BY A CYCLOTRON INSTABILITY PROCESS WITH APPLICATIONS TO THE THEORY OF HYDROMAGNETIC WHISTLERS. Jacobs, J. A.; (Univ. of British Columbia, Vancouver, Can.); Watanabe, T. J. Atmos. Terrest. Phys., 28: 235-53(Feb. 1966).

Cyclotron instabilities in hydromagnetic (abbreviated hm hereafter) waves in the magnetosphere are investigated as a possible origin of geomagnetic micropulsations. Emphasis is placed on instabilities related to the ion resonance mode of waves, which are relevant to hm whistlers. They may be caused by both an electron and a proton stream. The instability set up by an electron stream is convective which is synonymous with a traveling amplifying wave. The instability set up by a proton stream, however, is nonconvective, i.e. it behaves as a self-exciting oscillator. Despite the difference in the instability mechanisms, a hm signal in the magnetosphere generated by either process gives an observable effect on the earth's surface. A proton stream with a velocity of the order of 10^8 cm/sec is able to cause an instability with frequencies comparable to those of hm whistlers, several fractions of 1 c/s to several c/s, at a distance of several earth radii. It is not unreasonable to expect a sufficiently high growth rate, say, 10^{-1} per sec. Electrons, however, must be relativistic to cause an instability at a comparable frequency. Protons, therefore, seem to be more favored as the origin of hm whistlers. (auth)

19667 WHISTLER STUDIES OF THE PLASMAPAUSE IN THE MAGNETOSPHERE. 1. TEMPORAL VARIATIONS IN THE POSITION OF THE KNEE AND SOME EVIDENCE ON PLASMA MOTIONS NEAR THE KNEE. Carpenter, D. L. (Stanford Univ., Calif.). J. Geophys. Res., 71: 693-709(Feb. 1, 1966).

The position of the knee in the density of magnetospheric ionization was measured on a high time-resolution basis using whistlers recorded during July and part of August 1963. (The knee is an abrupt decrease in magnetospheric ionization density, frequently observed at field lines with an equatorial radius of about 4 R_E.) The data were obtained at Eights (64°S dipole latitude) and Byrd (70°S dipole latitude) in the Antarctic. The whistler results and results from other experiments confirm that the knee is a regular feature of the magnetosphere. For conditions of steady, moderate geomagnetic agitation ($K_p = 2-4$), the diurnal variation in geocentric equatorial range to the knee is remarkably repeatable. It is characterized by: a slow inward movement of the knee on the nightside, covering about 1.5 R_E in 10 hours; a slight outward movement on the dayside covering about 0.5 R_E; and a rapid outward shift in the late afternoon covering about 1 R_E in 1 hour. During periods of changing magnetic activity, the knee position changes with at most a few hours' delay, moving inward with increasing magnetic activity. The results from Eights and Byrd may be generalized to describe a three-dimensional model of thermal ionization in the magnetosphere involving a dense

(~100 el/cm³) inner region and a tenuous (~1 el/cm³) outer region separated by a sharp field-aligned boundary, the plasmapause. During the postmidnight hours, the inward motion of the knee involves a corresponding inward motion of the ionization just inside the plasmapause. The rapid outward shift of the knee near 1800 LT does not involve an outward plasma motion, but instead involves the presence of a region of "new" high-density (~100 el/cm³) plasma in the equatorial range of about 4–5 R_E. Preliminary evidence shows that, at least in the period 0000–1700 LT, the ionization inside the plasmapause rotates at approximately the angular velocity of the earth. (auth)

19668 WHISTLER STUDIES OF THE PLASMAPAUSE IN THE MAGNETOSPHERE. 2. ELECTRON DENSITY AND TOTAL TUBE ELECTRON CONTENT NEAR THE KNEE IN MAGNETOSPHERIC IONIZATION. Angerami, J. J.; Carpenter, D. L. (Stanford Univ., Calif.). J. Geophys. Res., 71: 711-25(Feb. 1, 1966).

A study was made of electron density and total electron content in tubes of force near the knee in magnetospheric ionization. It was based on whistler observations made at Eights, Antarctica, in July and August 1963, under conditions of steady, moderate geomagnetic agitation ($K_P = 2-4$). During the period 0100–0400 LT, the electron density near the equatorial plane at a geocentric distance of 4 R_E drops a factor of 30–100 within a distance of less than 0.15 R_E. The corresponding change in tube content above 1 cm² at 1000 km is a factor of about 10 within less than a degree of latitude. The afternoon profiles are generally similar to the postmidnight results. In the afternoon the profiles are often well defined outside the knee, falling smoothly to about 1 el/cm³ at 7 R_E. Both the equatorial and tube content profiles show a definite repeatability between observations at a given local time and under conditions of moderate, steady geomagnetic agitation. Diurnal effects are evident, with amplitude differing from point to point on the profiles. The problem of the field-line distribution of ionization was studied with a view to minimizing error in the profiles. Experimental and theoretical support was found for using a diffusive-equilibrium distribution along the field lines inside the knee and a "collisionless" model, behaving approximately as $N_e \propto R^{-4}$, along the field lines outside the knee. A study of error shows that the uncertainty in individual points on the knee profiles is everywhere less than a factor of ±2, and on the content profiles less than a factor of ±1.5. (auth)

19669 DETERMINATION OF HYDROGEN ION CONCENTRATION, ELECTRON DENSITY, AND PROTON GYROFREQUENCY FROM THE DISPERSION OF PROTON WHISTLERS. Gurnett, Donald A.; Shawhan, Stanley D. (Univ. of Iowa, Iowa City). Contract Nonr 1509(06). J. Geophys. Res., 71: 741-54(Feb. 1, 1966).

A method for determining H^+ concentration, electron number density, and proton gyrofrequency in the vicinity of a satellite by measurements of the asymptotic frequency-time profile of a proton whistler near the proton gyrofrequency is discussed. This new technique is applied to proton whistlers received by the Injun 3 VLF receiver. The calculated values of H^+ concentration and electron density are shown to be in good agreement with measurements by other experimenters at similar altitudes, latitudes, and local times. B values calculated from the proton gyrofrequency are compared with values calculated from the Jensen and Cain expansion for the geomagnetic field. It is shown that the wave energy of a proton whistler is guided very nearly along the geomagnetic field and that the parallel component of the group velocity is closely approximated by the group velocity for longitudinal propagation. It is found that for frequencies near the proton gyrofrequency at the satellite the kernel multiplying $n(H^+)^{1/2}$ in the travel-time integral is large only in the region near the satellite. Assuming that the H^+ concentration is uniform within this region, an expression is derived for the travel time of a proton whistler near the proton gyrofrequency. The H^+ concentration and proton gyrofrequency are obtained by fitting this theoretical frequency-time expression to observed proton whistler signals. By combining this method for determining $n(H^+)$ with the crossover frequency method for determining $\alpha_1 = n(H^+)/n_e$ the electron density can also be determined. (auth)

19670 LOW-ENERGY COLLISIONS BETWEEN SOME ATMOSPHERIC IONS AND NEUTRAL PARTICLES. Stebbings, R. F.; Turner, B. R.; Rutherford, J. A. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract DA-49-146-XZ-354. J. Geophys. Res., 71: 771-84(Feb. 1, 1966).

Collisions, involving charge transfer and charge rearrangement, between some of the positive ions and neutral molecules present in the earth's upper atmosphere were investigated in a crossed beam experiment at energies within the range 2 to 200 ev. The charged reaction products are identified in a mass spectrometer, and absolute cross sections for their production are obtained. Interpolation between these values and those obtained at thermal energy in afterglow experiments provides information on the variation of the cross sections with energy in the intervening energy interval. The influence of excited ions is examined in some detail. (auth)

19671 ENERGY SPECTRUM FOR AURORAL-ZONE X RAYS. 1. DIURNAL AND TYPE EFFECTS. Barcus, J. R.; Rosenberg, T. J. (Univ. of California, Berkeley). Contract Nonr-3656(13). J. Geophys. Res., 71: 803-23 (Feb. 1, 1966).

Balloon observations of x rays produced by energetic (~50–250 kev) electron precipitation into the auroral zone suggest a rather consistent diurnal pattern of occurrence for certain types of bremsstrahlung activity. Distinguishing spectral characteristics and variability, represented by approximate e-folding energies in the range 10–50 kev, are emphasized. Whereas the harder spectrums ($E_0 \approx 25-50$ kev) may be precipitated at any local hour, the softer spectrums ($E_0 \approx 10-25$ kev) appear primarily between the midnight and noon meridians. The softest spectrums ($E_0 \approx 10-15$ kev) observed in this energy range occur preferentially around midnight and into the early morning in association with pronounced negative magnetic bays and post-breakup auroral activity. The results suggest the existence of an intermediate spectrum ($E_0 \approx 10-25$ kev), in addition to the very soft ($E_0 \lesssim 5$ kev) precipitation characteristic of the luminous aurora and the rather harder precipitation ($E_0 \gtrsim 25$ kev) characteristic of the "average" auroral-zone x-ray event. (auth)

19672 ENERGY SPECTRUM FOR AURORAL-ZONE X RAYS. 2. SPECTRAL VARIABILITY AND AURORAL ABSORPTION. Barcus, J. R.; Brown, R. R. (Univ. of California, Berkeley). J. Geophys. Res., 71: 825-34 (Feb. 1, 1966).

Simultaneous measurements of bremsstrahlung x rays and ionospheric absorption in the auroral zone demonstrate the importance of spectral variability in energetic electron precipitation for the interpretation of D-region effects. Although the observations are generally consistent with present knowledge of upper atmospheric processes, they suggest a less dominant role for nighttime detachment below 70–80 km than has previously been assumed. (auth)

19673 LOCALIZATION AND MOTION OF ENERGETIC ELECTRON PRECIPITATION DURING MAGNETIC BAYS. Gosling, J. T. (Univ. of California, Berkeley). J. Geophys. Res., 71: 835-48(Feb. 1, 1966).

Balloon observations are presented that show directly the motions of energetic electron precipitation regions during negative magnetic bays. Comparison of these motions with those of the auroral electrojets indicates that the precipitation and current systems have similar locations and movements, as was inferred earlier by indirect means. In addition, a late morning event, without accompanying magnetic activity, was observed that showed similar localization and displacement. (auth)

19674 ON THE DISTRIBUTION OF ELECTRIC FIELDS IN THE MAGNETOSPHERE. Block, Lars P.

(Royal Inst. of Tech., Stockholm). J. Geophys. Res., 71: 855-64(Feb. 1, 1966).

The magnetic storm theories of Alfvén, Axford, Hines, and Dungey imply that an electrostatic potential difference exists across the magnetosphere. The detailed distribution of the resulting electric fields is, as yet, unknown. The present study is an attempt to solve this problem, assuming that a plasma with continuous energy spectrum is injected, by some unknown mechanism, into the magnetosphere. It is shown that space charges will occur owing to the different forbidden regions for particles of different charge and energy. The space charges will tend to suppress the applied potential and to push the field toward the outer parts of the magnetosphere, leaving a field-free region in the center. The size of the field-free region depends on the applied potential and the density and spectrum of the injected particles. The field-free region may be identified with the region containing the whistler medium. Outside this region the thermal plasma is swept away by the electric fields. In a first tentative approximation the auroral zone is found to be situated at an L value 52% larger than the L value of the field-free boundary. (auth)

19675 PHASE CHARACTERISTICS OF GEOMAGNETIC MICROPULSATIONS. Herron, Thomas J. (Columbia Univ., Palisades, N. Y.). Contract Nonr 266(48). J. Geophys. Res., 71: 871-89(Feb. 1, 1966).

Midlatitude geomagnetic micropulsations in the 15- to several-hundred-second period range were recorded simultaneously at stations separated a few hundred kilometers in east-west and north-south directions. Diurnal patterns of phase difference between stations were detected in which the station nearer the dark hemisphere usually led in phase. The magnitude of the phase lags is shown to be a function of period. Although absolute phase velocities could not be determined, the dispersive properties of the propagation medium were investigated. Apparent phase velocity curves were constructed from measurements of phase lags of many micropulsation signals recorded at all hours of the day and night. In addition, Fourier transform analysis of isolated Pt type signals permitted determination of apparent phase velocity and apparent group velocity curves of single signals. Apparent phase velocity increases with decreasing period. Energy propagation of Pt's is associated with a group velocity maximum. Uncertainty of the proper sign of the apparent group velocity prohibits a deduction of diurnal patterns of energy propagation from the diurnal phase lag patterns. (auth)

19676 DIURNAL PROPERTIES OF THE HORIZONTAL GEOMAGNETIC MICROPULSATION FIELD IN NEW ZEALAND. Christoffel, D. A.; Linford, J. G. (Victoria Univ. of Wellington, New Zealand). J. Geophys. Res., 71: 891-7(Feb. 1, 1966).

Geomagnetic micropulsations in the period range 5 to 200 seconds were recorded near Wellington, New Zealand. The activity occurring during July 1964 was analyzed for variations as functions of time in period and polarization. For the horizontal field of the daytime Pc 3 activity it was found that the period had a diurnal variation with a minimum generally around local noon, the field has a mainly anticlockwise sense of rotation or was linearly polarized, the oscillating vector's direction changed in a characteristic pattern throughout the day, the most rapid variations occurring near sunrise and sunset. The results cannot be explained adequately in terms of existing theories of micropulsations. A method for drawing equivalent overhead current patterns from single-station observations is proposed. (auth)

19677 VLF PHASE PERTURBATIONS PRODUCED BY THE SOVIET HIGH-ALTITUDE NUCLEAR EXPLOSION OF NOVEMBER 1, 1962. Zmuda, A. J.; Haave, C. R.; Shaw, B. W. (Johns Hopkins Univ., Silver Spring, Md.). Contract NOw 62-0604-c. J. Geophys. Res., 71: 899-910 (Feb. 1, 1966).

The Soviet high-altitude nuclear burst of 0912 UT on November 1, 1962, produced delayed perturbations of the v-l-f transmissions monitored at APL/JHU over five paths remote from the burst region. The burst-related v-l-f effects varied from 6 to 55% and averaged 32% of the normal diurnal variation. It is suggested that the v-l-f phase perturbations are produced by particles from the burst that drift to the remote regions and produce an ionization enhancement in the lower ionosphere in their first, and sometimes in their second, global orbit. The temporal histories of the v-l-f phase perturbations are compatible with a model wherein it is assumed that the trapped particles are electrons from the radioactive decay of neutrons, the artificial belt extending from an outer shell of $L \approx 3.4$ to at least $L = 1.9$. Satellite particle data do not show an artificial belt of electrons from the decay of neutrons, a belt which in this case may have been obscured by the background flux of electrons from the natural Van Allen belt and from the artificial belts from the earlier Soviet explosions. Satellite data do, however, show a narrow belt of fission electrons $\gtrsim 1$ Mev with maximum flux at $L \approx 1.77$ and a lower boundary at $L = 1.73$. These fission electrons did not affect the v-l-f paths intercepted by these shells. The v-l-f and satellite data agree that fission electrons $\gtrsim 1$ Mev were not present on shells above $L \approx 1.9$. (auth)

19678 DOUBLE SUNSPOT CYCLE VARIATION IN TERRESTRIAL MAGNETIC ACTIVITY, 1884-1963. Chernosky, Edwin J. (Air Force Cambridge Research Labs. (OAR), Bedford, Mass.). J. Geophys. Res., 71: 965-74 (Feb. 1, 1966).

The 11-year sunspot-number (or -latitude) cycle is known to be accompanied by a similar period variation in terrestrial magnetic activity. A double sunspot-number cycle variation, the basic sunspot-magnetism cycle of about 22 years, is found to occur in geomagnetic activity also. This variation is evidenced in two ways. Biannual maximums (near the equinoxes) in terrestrial magnetic activity are more pronounced at and just after the years of sunspot-number cycle minimums of 1887, 1912, 1933, and 1954 than at the alternate sunspot cycle minimums. In the Zurich even-numbered cycles, the last half of the sunspot-number cycle is more active than the first half, and the converse is true for the odd-numbered cycles. The superposition of a sunspot-magnetism cycle variation in geomagnetic activity of about one-fourth of that associated with the sunspot-number cycle would account for the trends noted. There is also some indication that the autumnal equinoctial maximum tends to peak in September during the even-numbered cycles and in October during the odd-numbered cycles. The daily magnetic character figure C_i for the 29,219 days from 1884 through 1963 is used as the index of terrestrial magnetic activity. The difference found in the solar effect upon the earth for alternate cycle minimums would indicate that results obtained during this IQSY could not be accurately extrapolated to the next sunspot-number cycle minimum, a factor to be considered in the space survey program. (auth)

19679 GEOMAGNETIC AND SOLAR DATA. Lincoln, J. Virginia (Environmental Science Services Administration, Boulder, Colo.). J. Geophys. Res., 71: 975-7(Feb. 1, 1966).

Geomagnetic and solar data are presented for January to September 1965. The principal geomagnetic storm sudden commencements, activities, and ranges are given. Also selected geomagnetic and solar data for September 1965 are given, including the 3-hour range indices, magnetic characters, average amplitudes, and provisional sunspot numbers. (J.F.P.)

19680 DIURNAL VARIATION IN TRAPPED ELECTRON INTENSITIES AT L = 2.0. Williams, D. J. (Johns Hopkins Univ., Silver Spring, Md.). Contract NOw 62-0604-c. J. Geophys. Res., 71: 979-81(Feb. 1, 1966).

An observed longitudinal dependence of trapped energetic electron intensities at high B values and at middle latitudes observed on the dayside hemisphere was previously reported. Additional evidence is presented supporting the lowering of mirror points in the South African anomaly and the subsequent atmospheric scattering and energy loss that

cause the observed longitudinal asymmetry. These data also display a diurnal variation, caused by the atomsphere, in trapped-electron intensities at L = 2.0 at 1100 km. (J.F.P.)

19681 ANNUAL VARIATION OF AURORAL ABSORPTION. Basler, Roy P. (ACF Industries, Inc., Hyattsville, Md.). J. Geophys. Res., 71: 982-4(Feb. 1, 1966).

The theory that the annual auroral variation of absorption with its well-defined summer minimum can be explained by the seasonal change of orientation of the earth's dipole moment with respect to the sun-earth line, which is the direction of plasma flow, was tested. The seasonal variation was determined from more than 5½ years of data, with only the absorption at geomagnetic noon considered. From the results shown the points are observed to lie reasonably close to a straight line. Although the results are derived from data at only one station, the given annual variation of absorption is believed to be representative of the qualitative behavior of auroral absorption throughout the world. These results suggest an annual variation in world wide particle precipitation, but the mechanism controlling this variation is still unknown. (J.F.P.)

19682 DIURNAL VARIATION OF ENERGETIC TRAPPED ELECTRONS AND MAGNETIC ACTIVITY. Hook, J. L.; Parthasarathy, R. (Univ. of Alaska, College). J. Geophys. Res., 71: 990-6(Feb. 1, 1966).

The diurnal variation of the outer radiation belt of trapped electrons of energy above 500 kev is established, and its relation to geomagnetic activity is investigated. These results show a larger diurnal variation than that reported previously, but this diurnal variation seems to be significantly reduced during times of very low geomagnetic activity. A notable distortion of the radiation belt is found to exist only when the planetary index of magnetic activity $K_p \geq 2$. Histograms show the local time variation of the position of the structure of the belt. The drift in latitude and planetary magnetic index are also given. (J.F.P.)

19683 FLUCTUATION OF ATMOSPHERIC ^{14}C DURING THE LAST SIX MILLENNIA. Damon, Paul E.; Long, Austin; Grey, Donald C. (Univ. of Arizona, Tucson). J. Geophys. Res., 71: 1055-63(Feb. 15, 1966).

The initial ^{14}C contents of dendrochronologically dated tree rings were determined for samples covering the entire range of present tree-ring chronology which extends back to 3750 B.C. The initial ^{14}C content is within ±1.5% of the 1850 A.D. value during the Christian era, except for the period between 1500 and 1700 A.D. ($T_{½}$ = 5730 years). During that time Δ fluctuates between about 0 and +3.0%. There is a steady increase of about 4 mile per 100 years from 100 B.C. and continuing through the oldest dendrochronologically dated tree rings (California bristlecone, 3755 B.C.). The key date for the Egyptian Middle Kingdom astronomical chronology is the seventh year of the reign of Pharaoh Sesostris III of the Twelfth Dynasty. Wood samples associated with the reign of Sesostris III indicate a Δ value greater than 3.5%, which is consistent with the contemporaneous bristlecone pine tree ring Δ value of 6.7%. There no longer seems to be reasonable doubt concerning the reality of the fluctuation of the ^{14}C content of the atmosphere during historic time. The extent of variation during prehistoric time has yet to be established and the causal factors remain obscure. There appears to be a correlation between initial ^{14}C and climate. (auth)

19684 SECULAR VARIATION OF ATMOSPHERIC RADIOCARBON CONCENTRATION AND ITS DEPENDENCE ON GEOMAGNETISM. Kigoshi, Kunihiko; Hasegawa, Hiroichi (Gakushuin Univ., Tokyo). J. Geophys. Res., 71: 1065-71(Feb. 15, 1966).

The variation in atmospheric radiocarbon concentration during the last 1800 years was measured in a giant tree grown on Yaku Island in the southern part of Japan. The observed gradual decrease of radiocarbon concentration in the past agrees with the computed variation based on the paleomagnetic data, which show a dominant effect of variation of geomagnetic field strength on the variation of atmospheric radiocarbon concentration. (auth)

19685 AURORAL ZONE ELECTRON FLUX AND ITS RELATION TO BROADBEAM RADIOWAVE ABSORPTION. Parthasarathy, R. (Univ. of Alaska, College); Berkey, F. T.; Venkatesan, D. Planet. Space Sci., 14: 65-83(Jan. 1966).

The Injun III passes over the auroral zone stations of College (L = 5.5) and Fort Yukon (L = 6.3), Alaska, during January 1963–October 1963, are utilized for a comparison of fluxes of precipitating and "trapped" electrons with the instantaneous values of broad beam radio absorption at 27.6 Mc. The flux of precipitating electrons of energy E > 40 kev revealed clear control on the absorption magnitude. For a given precipitating flux of electrons of energy E > 40 kev, with pitch angles 0–43° over the zone, the magnitude of absorption increased with the increasing availability of the flux with pitch angles >43°. The trapped flux over the zone was, typically, ten to a hundred fold stronger than the precipitating flux, with only the instances of severe precipitation tending to be isotropic. The "trapped" flux as such (E > 40 kev) was poorly related to the magnitude of absorption; while the trapped flux, E > 250 kev, E > 1.5 Mev were found unrelated to the magnitude of absorption. The empirical relation between the precipitating flux ($cm^{-2}sec^{-1}ster^{-1}$) of E > 40 kev and the magnitude of broadbeam absorption at 30 Mc could be expressed as A(db) = $3.3 \times 10^{-3} \sqrt{N > 40 \text{ kev}}$ during the instances when the precipitation was more or less isotropic from the upper hemisphere. The empirical dependence of absorption is found to be approximately consistent with the calculated dependence of absorption, by estimating the electron density profile due to a primary electron spectrum of the form $N(E) = KE^{-4.5}$ ($cm^{-2}sec^{-1}ster^{-1}kev^{-1}$). (auth)

19686 MEASUREMENTS OF PARTICLE PRECIPITATION AT THE SOUTH POLE. Sharp, R. D.; Evans, J. E.; Johnson, R. G. (Lockheed Palo Alto Research Lab., Calif.). Planet. Space Sci., 14: 85-94(Jan. 1966).

Data on the precipitation of low energy particles on the south geographic pole were acquired from instruments aboard a polar-orbiting satellite which passed 340 km over the south geographic pole every 90 minutes during a 5-day period in October–November 1963. This particular location was unique in being both in the auroral zone and under each pass of the satellite. The particle detectors were sensitive to electrons of energies greater than 0.080 kev and protons of energies greater than 4 kev. The particles most often observed precipitating into the atmosphere were electrons of a few kev energy. The diurnal variation of the total precipitated energy flux exhibited a maximum at 10–12 hours U.T. during the period of the experiment. The particle measurements are compared with ground observations and other satellite measurements taken during the same period. The intensity of electron precipitation was better correlated with the local K-index than with K_p. (auth)

19687 ON EJECTION OF NEUTRAL HYDROGEN FROM THE SUN AND THE TERRESTRIAL CONSEQUENCES. Brandt, John C.; Hunten, D. M. (Kitt Peak National Observatory, Tucson, Ariz.). Planet. Space Sci., 14: 95-105(Jan. 1966).

A critical examination is made of a suggestion by Akasofu that large amounts of neutral hydrogen emitted from the sun may be responsible for the main phase of terrestrial magnetic storms. This suggestion encounters such overwhelming objections from the knowledge of solar, interplanetary, and terrestrial physics that it appears to be without sound foundation. (auth)

19688 PECULIARITIES IN THE AURORAL DISTRIBUTION AND MAGNETIC DISTURBANCE DISTRIBUTION IN HIGH LATITUDES CAUSED BY THE ASYMMETRICAL FORM OF THE MAGNETOSPHERE. Feldstein, Y. I. (World Information Centre B2, Moscow). Planet. Space Sci., 14: 121-30(Feb. 1966).

The dependence of the frequency distribution of auroral displays in the zenith on latitude and on local time in magnetically quiet ($K_p \leq 1$) and magnetically disturbed ($K_p \geq 5$) periods is investigated using observational data from the all-sky camera network in the northern hemisphere for

1957–1959. The positions of the auroral zones on the night and day sides of the earth in both types of period are determined. They show marked asymmetry. The results of the statistical analysis of the distribution are supplemented by synoptic charts at fixed instants of universal time on 13 and 23 December 1957. The S_p variation of the H, Z and D-components of the geomagnetic field are calculated from observational data on the geomagnetic field variations obtained at 24 high-latitude observatories in the northern hemisphere. It is shown that the distribution of the disturbed vector agrees with the assumed intensive current in the ionosphere flowing westwards along the asymmetrical auroral zone. (auth)

19689 THE S_q OVERHEAD CURRENT SYSTEM APPROXIMATION. Winch, D. E. (Univ. of Sydney). Planet. Space Sci., 14: 163-72(Feb. 1966).

An examination is made of the assumption that rotation of the horizontal component of the quiet day transient geomagnetic variation (S_q) field clockwise through 90°, gives a vector which shows the direction and which is proportional to the intensity of the overhead current system corresponding to the S_q field. Expressing the results in the form of a current function shows that the assumption leads to an error of approximately 10 per cent, at least, of the maximum overhead current circulation for the current system corresponding to the S_q field, with the largest errors occurring in middle and equatorial latitudes. Current functions have been recomputed from the results of an earlier spherical harmonic analysis of the S_q field, and show discrepancies from the current systems first given and subsequently reprinted many times. (auth)

19690 A STUDY OF PULSATING AURORA. Johansen, O. E. (Norwegian Inst. of Cosmic Physics, Blindern, Norway); Omholt, A. Planet. Space Sci., 14: 207-15(Feb. 1966).

Observations of pulsating aurora from Tromsö during the winter 1964/65 are reported. From the characteristics of the pulsations observed, these have been divided into three different types. A power spectrum analysis of the intensity variations was performed, and from the ratio between the high frequency content (>0.25 sec^{-1}) the observed pulsations were divided in three different groups. Studies of the time distribution of the observations show that the quoted ratio tends to decrease during the night. The observations do not in general lend support to the theory that the pulsations are due to semi-trapped electrons. (auth)

19691 A POSSIBLE RELATION BETWEEN PULSATIONS IN THE AURORAL LUMINOSITY AND THE ENERGY SPECTRUM OF THE PRIMARY PARTICLES. Johansen, O. E. (Norwegian Inst. of Cosmic Physics, Blindern, Norway). Planet. Space Sci., 14: 217-19(Feb. 1966).

Observations which indicate a relation between the frequency spectrum of pulsations in the auroral luminosity and the energy spectrum of the auroral electrons are presented. Because auroral luminosity and auroral absorption are produced mainly by electrons with different energies, simultaneous observations with photometer and riometer give information about the approximate energy spectrum of the incident electrons. (B.G.D.)

19692 TRANSMISSION AND COUPLING RESONANCE OF HYDROMAGNETIC DISTURBANCES IN THE NON-UNIFORM EARTH'S MAGNETOSPHERE. Tamao, Tsutomu (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., Fifth Ser., 17: 43-72(Dec. 1965).

Using the approximate dipole coordinates which are valid near the equatorial plane, characteristics of hydromagnetic oscillations are studied for the nonuniform model magnetosphere. For the first approximation such as the cold plasma without inter-particle collisions the coupling equation between the transverse and the isotropic mode hydromagnetic disturbances is derived. It is shown that there may be a coupling resonance region wherein the intensity of perturbations becomes singular. The radial position of this resonance between the incident three-dimensional disturbances and the local transverse oscillation of the field line depends on the period and wave number of disturbances considered. As possible second order corrections effects of Hall current, collisional dissipations of Joule and viscosity, the thermal dissipation and the generation of longitudinal mode of oscillations along field lines for a hot plasma are considered. When dissipation is included, singularity at the resonance vanishes and the direction of Poynting flux of disturbances becomes completely parallel to the direction of field lines near the resonance region. For a particular model with dissipation the spatial distribution of components of magnetic perturbations shows an outstanding narrow peak of the azimuthal component at the resonance level. It is shown that the energy of three-dimensional hydromagnetic disturbances from the outermost part of the magnetosphere will be almost entirely converted into the local transverse mode oscillations near the resonance region. Both the collisional and thermal dissipations are not remarkably effective for reducing the resonance singularity for the magnetospheric condition. Hence the generation of the secondary longitudinal mode oscillation may be a possible mechanism for disappearance of the singularity. It is pointed out that coexistence of two kinds of plasmas, the background thermal and the energetic, cause the hydromagnetic instability if the pressure anisotropy of energetic particles has the deviation from unity, and that this instability within the ring current region may be a possible source of geomagnetic pulsations. A discussion is given of a non-linear effect of disturbances in the outer magnetosphere on the latitudinal distribution of the intensity of pulsations at the earth's surface and on the precipitation of charged particles into the ionosphere. (auth)

19693 ON THE CHARACTER OF THREE-DIMENSIONAL HYDROMAGNETIC WAVES IN A UNIFORM COLD PLASMA. Takei, Shigeo (Tohoku Univ., Sendai). Sci. Rep. Tohoku Univ., Fifth Ser., 17: 73-105(Dec. 1965).

The character of three-dimensional hydromagnetic waves in a uniform cold plasma is studied in relation to the energy transport mechanism in the magnetosphere. It is found that hydromagnetic waves can be described in two different ways; they are considered to be composed of the "modified transverse (MT-) mode" and the "direct transverse (DT-) mode," or of the "modified isotropic (MI-) mode" and the "direct isotropic (DI-) mode." The DT-mode and the DI-mode are directly resulted from a source field or an initial field, and they propagate as purely one-dimensional waves or purely isotropic waves, respectively. On the other hand, the MT-mode and the MI-mode are of complicated nature, the former being excited by a compressional force and the latter by a torsional force, respectively. Neither of the MT-mode and the MI-mode are one-dimensional nor isotropic waves, but are of hybrid nature. The phase and the attenuation of the fields accompanying these modes are considered in detail. The result is that hydromagnetic waves, even in case the system is asymmetric, can transport the energy to any points without destruction of the initial form, although the space attenuation is highly anisotropic. Furthermore the two scalar wave equations are derived to solve the boundary value problems, and some kinds of surface waves are shown to exist in a two-layered plasma. (auth)

19694 EARTH'S MAGNETIC FIELD: A NEW LOOK. Ness, Norman F. (Goddard Space Flight Center, Greenbelt, Md.). Science, 151: 1041-52(Mar. 4, 1966).

A history of knowledge of the structure of the geomagnetic fields is given including recent determinations. This structure is considered in detail. The topics include the solar wind effects, the magnetosphere and magnetopause, distortion of the field, the interplanetary medium, the earth's magnetic tail, and geomagnetic storms. The results from Mariners II and IV are also mentioned. (J.F.P.)

19695 THEORY OF FORMATION OF THE IONOSPHERE. Yonezawa, T. (Radio Research Labs., Tokyo). Space Sci. Rev., 5: 3-56(Jan. 1966).

Current knowledge about the solar radiation and ab-

sorption and ionization cross sections of atmospheric gases is reviewed. Next the main observed features of ionospheric layers are summarized. Using CIRA 1965 model atmospheres the heights of the peak of the ionization rate are calculated for a number of solar emission lines and it is made clear which of these lines are responsible for the formation of E and F1 layers. The mechanism of electron removal in the F and upper E regions as well as in the lower regions is considered, and the mechanism of formation and some behaviors of each ionospheric layer is discussed. In particular, the equatorial F2 layer is briefly considered. Discrepancies are pointed out between the values of the recombination coefficient and the rate constant for ion-atom interchange reaction obtained from ionospheric observations and from laboratory experiments. Inconsistency of the values of the intensity of solar radiation measured by rocket techniques and inferred from ionospheric considerations is also noted. Some evidence is presented suggesting that corpuscular radiation may be responsible for part of the ionization in the ionosphere even in temperate latitudes. (auth)

19696 ELECTRODYNAMICS OF THE IONOSPHERE. Maeda, K.; Kato, S. (Kyoto Univ.). Space Sci. Rev., 5: 57-79(Jan. 1966).

Various important studies in the field of electrodynamics of the ionosphere are reviewed. Four topics are presented; conductivity, wind and the dynamo theory, drift and its effect on the ionosphere formation and interaction between wind and electromagnetic field. Some important future problems are pointed out. They are: There is a need to consider in the dynamo theory of the geomagnetic daily variation the connection of the ionosphere of both hemispheres by lines of force of the geomagnetic field. Nonperiodic wind may be important for producing electric field. Drift to cause interchange of ionization contained in tubes of the geomagnetic field lines, and diffusion of ionization in these tubes control dynamic behaviors of the F2 region. Interaction between wind and electric current presents a new problem. The ionosphere and the magnetosphere react to each other. (auth)

19697 EXPLORING THE RADIATION BELTS. Vector (Baltimore), 19: 8;40(Jan. 1965).

Earlier investigations of extraterrestrial radiations and the discovery of the Van Allen radiation belts are traced, and present status of knowledge in this field is briefly reviewed. Also considered are the aftereffects of the detonation of the STARFISH device over Johnston Island July 9, 1962 which created a low-altitude artificial radiation belt. (TCO)

Gravitation, Quantum Mechanics, and Relativity Theory

Refer also to abstract 19410.

19698 (NP-15931) REMARKS ON THE MOTION IN GRAVITATIONAL FIELDS OF EXTENDED MASSES. Kuchowicz, Bronislaw (Warsaw Univ. (Poland). Dept. of Radiochemistry). Jan. 1966. 8p. Dep.

It was previously shown that for certain values of the physical parameters the neutrinos either do not escape from an incompressible fluid sphere or they may return inside after they have left the sphere for a part of their motion. The same results apply to other zero rest mass particles irrespectively from their nature. It is anticipated that such speculations may find application for neutron stars and quasars. They may be even generalized to other, more realistic gravitational fields. Besides, they may be extended to particles with finite rest mass. This may be performed in a straightforward way for central symmetric gravitational fields. Brief remarks on this are presented. (M.O.W.)

19699 (UCRL-14643-T) NUMERICAL TREATMENT OF AN ELEMENTARY QUANTUM MECHANICS PROBLEM. Fritz, Karl (Lawrence Radiation Lab., Univ. of California, Livermore). Jan. 7, 1966. Contract W-7405-eng-48. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

It is shown that approximating the Schroedinger equation with a particular simple potential by a finite-difference equation and solving the eigenvalue problem by setting the determinant of the coefficients equal to zero is a convergent procedure for all eigenvalues if it converges for the lowest eigenvalue. Furthermore, it is likely that the eigenvectors converge to their respective eigenfunctions. (D.C.W.)

19700 RELATIVISTIC RIGID BODIES AND THE UNCERTAINTY PRINCIPLE. Hart, Robert R. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Amer. J. Phys., 33: 1006-7(Dec. 1965).

Special relativity excludes the existence of rigid bodies, since such bodies can be used to transmit signals instantaneously. It is pointed out that the uncertainty principle requires that a force of order hc/l^2 must be available if a rigid body of length l is to be used to produce such a violation of relativistic causality; a condition which is particularly stringent in the domain of elementary particles. Thus, where a force of this magnitude is not available, the treatment of bodies of length l as rigid may be valid. (auth)

19701 OBSERVER TIME AS A COORDINATE IN RELATIVISTIC SPHERICAL HYDRODYNAMICS. Hernandez, Walter C. Jr.; Misner, Charles W. (Univ. of Maryland, College Park). Astrophys. J., 143: 452-64 (Feb. 1966).

It is shown that space-time events at which $2Gm/c^2R > 1$ holds in a spherically symmetric, inward-moving fluid satisfy Penrose's criterion for a "trapped surface" so that light rays leading from these events can never escape to infinity but instead terminate in a singularity. [Here $2\pi R$ is an invariantly defined "circumference" coordinate and m(r,t) is a function obtained from a certain curvature invariant.] The singularities which follow the formation of such a "trapped surface" or "Schwarzschild surface," although unobservable in principle, halt numerical computations of spherically symmetric hydrodynamics problems using a diagonal metric before the more slowly moving regions outside the Schwarzschild surface have completed their observable motions. By using a retarded time coordinate u the relativistic equations are reformulated in such a way that time dilation effects prevent the formation of Schwarzschild surfaces at finite values of u while allowing all observable aspects of the dynamics to proceed. The treatment of energy transfer by radially outward-moving radiation is also greatly simplified by the use of this retarded time coordinate. (auth)

19702 AN ESTIMATION OF GREEN'S FUNCTION OF THE SCHROEDINGER OPERATOR $Bu = -\Delta u + q(\chi)u$ WITH SINGULARITIES IN THE POTENTIAL $q(\chi)$. Gagla, R. (Univ. of Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 13: 723-6(1965).

Some estimates are given of the Green's function of the operator, Au, in the case when the potential $q(\chi)$ has a countable set of singularities in the points P_n (of three-dimensional Euclidean space E^3) in which $q(\chi) = O\{1/|x - P_n|^{a_n}\}$ where $a_n < 1.5$. It is remarked that these cases are important in the quantum theory of crystals. (J.F.P.)

19703 THE CAUCHY PROBLEM FOR THE COUPLED MAXWELL AND DIRAC EQUATIONS. Gross, Leonard (Cornell Univ., Ithaca, N. Y.). Contract AF-AFOSR-342-63. Commun. Pure Appl. Math., 19: 1-15(Feb. 1966).

The existence and uniqueness of solutions of the Cauchy problem globally in space and locally in time, i.e., in a space-time region $0 \leqq t \leqq T$, where T depends on the initial data, are established. The space of initial conditions is the largest for which strong solutions are logical for a hyperbolic system. (J.F.P.)

19704 RELATIVITY AND ELECTRICITY. Elliott, R. S. (Univ. of California, Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 3: 140-2; 147-52(Mar. 1966).

Several facets of the special theory of relativity are re-

viewed, commencing with the Lorentz equations and culminating in the force transformation law. The basic equations of electrostatic theory are then formulated, after which a relativistic transformation of Coulomb's law is undertaken, the result being the Lorentz force law. Time-varying electric and magnetic fields are defined as constituent terms of the Lorentz force expression and are then shown to satisfy Maxwell's equations. The development includes derivations of the relativistic transformation laws for sources and fields. (auth)

19705 ON A DERIVATION OF A QUANTUM-MECHANICAL LINEARIZED BOLTZMANN EQUATION. Hoffman, David K. (Univ. of Adelaide). J. Chem. Phys., 44: 2644-51(Apr. 1, 1966).

Methods recently developed to derive the classical Boltzmann equation were extended to quantum mechanics. (auth)

19706 ERROR BOUNDS FOR APPROXIMATIONS TO EXPECTATION VALUES OF UNBOUNDED OPERATORS. Bazley, Norman W. (Institut Battelle, Geneva); Fox, David W. J. Math. Phys., 7: 413-16(Mar. 1966).

A bound for $|(B\Psi,\Psi) - (B\varphi,\varphi)|$, the error between the expectation value of a self-adjoint operator B on an eigenfunction Ψ of a self-adjoint Hamiltonian H and the value given by an approximating vector φ, is obtained when H is a radial Schödinger operator and B is multiplicative and unbounded. The analysis makes use of point and asymptotic estimates for Ψ. (auth)

19707 ON THE COMPLEX STRUCTURE OF THE UNIVERSE. Brown, Edmund H. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). J. Math. Phys., 7: 417-25(Mar. 1966).

A complex space-time is constructed from physical axioms. Both gravitational and electromagnetic fields are approximations to parts of a geometric object defined on this complex space, while other parts may represent strong and weak interactions. The intersections of the singularities of the three independent geometric invariants are identified as elementary particles. This identification leads to geometric definitions of mass and momentum and suggests the geometric significance of internal quantum numbers. (auth)

19708 SOME SPATIALLY HOMOGENEOUS ANISOTROPIC RELATIVISTIC COSMOLOGICAL MODELS. Kantowski, R.; Sachs, R. K. (Univ. of Texas, Austin). J. Math. Phys., 7: 443-6(Mar. 1966).

Some solutions of the Einstein field equations for a dust source are given in explicit form. They are spatially homogeneous, irrotational, and anisotropic. They can be characterized as those spatially homogeneous expanding models that do not permit a simply transitive three-parameter group of motions. The models are compared in detail with observations and with the Friedmann models. In a few instances slightly longer time scales are obtained with the present models than from the corresponding Friedmann models. (auth)

19709 MULTIPOLE MOMENTS IN EINSTEIN'S GRAVITATIONAL THEORY. Lamb, D. J. (King's Coll., London). J. Math. Phys., 7: 458-63(Mar. 1966).

Janis and Newman have proposed definitions of multipole moments of axially symmetric gravitational fields in terms of the initial data on a characteristic surface. Their definitions are extended to source distributions without symmetry by considering the electromagnetic and linear gravitational fields. The global definition of four-momentum agrees, for sandwich waves, with the objects constructed by Møller and Cornish in their attempts to provide a local definition of four-momentum. (auth)

19710 THEOREM ON GRAVITATIONAL FIELDS WITH GEODESIC RAYS. Unti, T. W. J.; Torrence, R. J. (Univ. of Pittsburgh). J. Math. Phys., 7: 535-8(Mar. 1966).

If one of the Ruse vectors of a field is assumed to be a geodesic having nonvanishing divergence θ, curl ω, and complex shear σ, the only vacuum metrics that exist are found to be of the cylindrical type, where the geodesic rays obey $\theta^2 + \omega^2 = \sigma\bar{\sigma}$. (auth)

19711 SOLUTION OF THE BLOCH-NORDSIECK MODEL. Tarski, Jan (New York Univ., N. Y.). J. Math. Phys., 7: 560-73(Mar. 1966).

An operator solution is constructed for the Bloch-Nordsieck model, in the formulation of Bogolubov and Shirkov. The following are some of the features of the solution. (a) The method of solution depends on the following assumption: The renormalized electron current is identical with the free-field current. The resulting solution is consistent with this assumption. (b) The infraparticle structure of the electron is analogous to the infraparticle structure in Schroer's model. (c) The ordering of fields, i.e., the definition of their products, is considered in detail. A modification of Wick ordering (called F-ordering in the text) appears particularly satisfactory. (d) The solution allows a heuristic discussion of the infrared representations of the electromagnetic field. These depend, apparently, on the chosen velocity of the electron. (auth)

19712 GENERAL SPIN EQUATIONS IN TWO-COMPONENT AND DIRAC-LIKE FORM. Berg, R.A. (Lockheed Research Labs., Palo Alto, Calif.). Nuovo Cimento (10), 42A: 148-58(1966).

Nonzero mass particles of arbitrary spin can be shown to obey wave equations of simple form: (a) similar to the two-component mass-zero Dirac equation or (b) (for half-integer spin) exactly like the four-component ordinary Dirac equation with mass. Although the wave equation is simple in form, the Lorentz transformation properties of the wave function are complicated (except for spin $\frac{1}{2}$: the ordinary Dirac case). The limit of going to zero mass is related to the helicity representations for mass zero. The equations in the mass-zero limit are considered, and shown to be of the zero-mass two-component type for arbitrary helicity, where the two-component entities transform as spinors only for the helicity one-half case. (auth)

19713 LINEAR GROUPS AND GRAVITATION AND THE POSSIBLE COSMOLOGICAL ORIGIN OF $L_+^\uparrow$. Sueveges, M. (Hungarian Academy of Sciences, Budapest). Phys. Lett., 20: 265-6(Feb. 15, 1966).

Some experimental consequences of a theorem of congruence (invariance) in gravitational fields, proved previously, are pointed out. The theorem states that physical quantities are congruent under Levi-Civita transpost and it is pointed out that the transformations involved are linear homogeneous with non-singular matrices and they constitute a pseudo-group. It is shown that the crucial tests of relativity follow from the theorem and also that in the tangent spaces of a non-vacuum Einstein space the 6-dimensional $L_+^\uparrow$ is a good local group. (auth)

19714 MONOPOLE GRAVITATIONAL RADIATION. Sexl, R. U. (Univ. of Vienna). Phys. Lett., 20: 376-8 (Mar. 1, 1966).

It is shown that all theories of gravitation except general relativity predict monopole gravitational radiation. In theories with light deflection larger than the Einstein value the monopole field possess negative energy and could be the energy source of the quasars. (auth)

19715 ON THE CORRECTOR FORMULAS FOR THE NUMERICAL SOLUTION OF THE SCHROEDINGER EQUATION FOR CENTRAL FIELDS. Lovitch, L.; Rosati, S. (Univ., Pisa, Italy). Proc. Cambridge Phil. Soc., 62: 79-82(Jan. 1966).

A useful corrector formula was previously derived by Douglas and Ridley (Proc. Cambridge Philos. Soc., 51: 702(1955)) for the numerical evaluation of the Schroedinger equation for a particle in a central potential. Given a first estimate of the eigenvalue, this formula permits a better estimate using any standard integration procedure for the differential equation. Cooley (Math. Comp., 15: 363(1961)) obtained a similar corrector formula. It is shown that the Douglas-Ridley corrector formula has a quadratic convergence and that the Cooley formula may be derived directly from it. (J.F.P.)

19716 A SPATIALLY HOMOGENEOUS GRAVITATIONAL FIELD. Joseph, V. (Univ., Ceylon, Colombo). Proc. Cambridge Phil. Soc., 62: 87-9(Jan. 1966).

A solution of Einstein's vacuum field equations, apparently new, is exhibited. The metric, which is homogeneous (that is, admits a three-parameter group of motions transitive on space-like hypersurfaces), belongs to Taub Type V. The canonical form of the Riemann tensor, which is of Petrov Type I, is determined. (auth)

19717 DIFFERENTIAL CONSERVATION LAWS IN NONRELATIVISTIC QUANTUM MECHANICS. Grossmann, S. (Univ., Marburg, Ger.). Z. Phys., 191: 103-25 (Feb. 1966).

Differential conservation laws for quantum mechanical operator fields are studied from (a) some general point of view and (b) to find the particle, momentum and energy conservation law, if the hamiltonian is not local as usually assumed. Concerning (b): If the interaction in a many body system is nonlocal, the particle current operator in the continuity equation has to be redefined. Physical properties of the interaction current are discussed. Similar nonlocal effects must be taken care of in the stress and energy current operator. Concerning (a): Besides the mentioned conservation laws there are arbitrary many other ones. In fact, for each arbitrary field a class of corresponding currents exists and vice versa, which together are related by a differential conservation law. Some physical aspects for defining current operators are given and discussed. (auth)

19718 ON n^{th} ORDER COHERENCE IN QUANTUM ELECTRODYNAMICS. Ledinegg, E. (Technische Hochschule, Graz, Ger.). Z. Phys., 191: 177-98(Feb. 1966). (In German).

Analogous to the statistical moments for the description of classical light emission, correlation functions were carried out to the n^{th} order for the light-quantum field within the framework of quantum electrodynamics, which characterizes the coherence behavior of the field. The correlation terms are explicitly evaluated and investigated, especially the field states that belong to a coherence of the n^{th} degree. It is shown that for a field state $|>_K = \Sigma C_\nu^{(K)}|\nu>_K$, which correspond to a coherence of the n^{th} degree, a system of equations belong to the $\frac{1}{2}(3+n)n-1$ equations, which limits the free choice of $C_\nu^{(K)}$. By taking the limit for $n \to \infty$, the known Poisson distribution for the photon field is obtained directly. (tr-auth)

19719 BASIC CONNECTION BETWEEN THE SCHROEDINGER AND HAMILTON JACOBI THEORIES. Liebowitz, Benjamin. 16p. (CONF-651051-1). ORAU. Gmelin, AED-CONF-65-280-1.

From American Physical Society, New England Section, Fall Meeting, Orono, Me.

An attempt is made to provide a classical foundation for Schroedinger theory. Complex psi functions are introduced, and the time-dependent equation is derived. The Hamilton-Jacobi equations are used in the derivation of the Schroedinger equations. (D.C.W.)

Low Temperature Physics

Refer also to abstracts 19424, 19614, 20109, 20113, and 20160.

19720 (CEA-Bib-65) LES COUCHES MINCES SUPRACONDUCTRICES. APPLICATION A LA REALISATION DE MEMOIRES RAPIDES. (Superconducting Thin Films. Application to the Construction of Fast Storage Devices). Hesse, Michel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 30p. Dep. mn.

Superconductivity and its main properties are first presented. Then, application to fast digital storage devices is described by reviewing various realizations of binary cells and memory planes. (auth)

19721 (CLM-R-47) THE MEASUREMENT OF TEMPERATURE IN THE RANGE 3 DEG K TO 80 DEG K USING CARBON RESISTORS. Goodall, D. H. J. (Culham Lab., United Kingdom Atomic Energy Authority, Abingdon (England)). Sept. 1965. 15p. Dep. mn. BIS $0.50. HMSO 2s. 6d.

The low temperature characteristics of some commercial carbon resistors are obtained using a vapor pressure thermometer as a standard. The temperature characteristics calculated from three resistance measurements near 4, 20, and 77°K give a good approximation to the experimentally determined characteristics. The stability of the resistors improves with time and thermal cycling, and is better than ±1% at 4.2 and 77°K. (auth)

19722 (N-65-17099) INVESTIGATION OF THE SUPERCONDUCTING PROPERTIES OF TRANSITION METAL ALLOY SYSTEMS. Final Report. (Little (Arthur D.) Inc., Cambridge, Mass.). Aug. 1964. Contract NASw-733. 20p. (NASA-CR-60717). CFSTI $1.00 cy, $0.50 mn.

The critical current characteristics of niobium–zirconium superconducting alloys were investigated. This study was concerned with the effect of the ω-transformation on superconductivity. The transformation was studied in detail, and the purpose was to apply this knowledge to the changes in superconducting properties as the transformation occurs. (auth)

19723 (N-65-17508) STUDY OF SUPERCONDUCTING THIN FILMS. Final Report. Fowler, Peter (National Research Corp., Cambridge, Mass. Research Div.). Mar. 25, 1963. Contracts NAS7-100; JPL-950303. 35p. (NASA-CR-60873). CFSTI $2.00 cy, $0.50 mn.

For Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

Superconducting properties in fields as high as 30,000 oersteds are reported for Nb films. Critical current densities at zero external magnetic fields were in the order of 10^6 amp/cm^2. The preparation of Nb_3Sn coatings by codeposition of Nb and Sn vapors onto a substrate heated to less than 300°C was also reported. (STAR)

19724 (N-65-25286) THE USE OF SUPERCONDUCTORS FOR GENERATION OF HIGH MAGNETIC FIELDS. PART I. MATERIALS CAPABLE OF SUPPORTING LARGE SUPERCURRENT DENSITIES. Lindenbaum, Samuel D. (Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.). Nov. 1964. 53p. (RE-194).

The use of superconductors for the generation of high magnetic fields is primarily concerned with materials capable of supporting large supercurrent densities. The advantages in the use of superconducting magnets over conventional magnets are pointed out, with reference to specific examples. The historical development of superconductors with large current-carrying capacity in high magnetic fields, and their possible use for magnets, is traced from the time of the discovery of superconductivity up to the present. The physical bases for high-field superconductivity are discussed, and the distinguishing features of type-I and type-II superconductivity are illustrated. (STAR)

19725 (NASA-TN-D-3344) CURRENT DISTRIBUTION IN A THIN FILM SUPERCONDUCTING STRIP TRANSMISSION LINE. Sass, A. R.; Skurnick, I. D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1966. 27p. CFSTI $0.40 cy, $0.50 mn.

In the long wavelength limit the current distribution in a thin film superconducting strip transmission line can be described by an inhomogeneous Fredholm integral equation of the second kind. When a fluxoid conservation derivation of this equation is considered, physical insight into the structure of the kernel follows naturally. An approximate analytic solution to the integral equation is derived for a specified range of geometrical parameters commonly encountered in practice. The solution is obtained by making use of the Liouville-Neumann method of successive approximations, and by approximating the resulting series by a series involving powers of a defined coupling factor. It is shown that the critical current of the thin film superconducting strip transmission line is underestimated by less than 10 percent. (auth)

19726 SUPERCURRENTS THROUGH BARRIERS. Josephson, B. D. (Cambridge Univ., Eng.). Advance. Phys., 14: 419-51(Oct. 1965).

Superconducting systems partitioned by barriers which are thin enough to allow supercurrents to pass through them are discussed. The implications for such systems of superconducting long-range order are considered, and a phenomenological theory is developed and applied to a number of topics: penetration of a magnetic field into a barrier, interference of supercurrents in the presence of a magnetic field, the cut-off frequency associated with the propagation of electromagnetic waves along a barrier, a-c supercurrents, and structure in the d-c current–voltage characteristics of a barrier resulting from an applied microwave field or the a-c supercurrent. The phenomenological theory is justified by the use of microscopic theory, and a new approach, based on the Gor'kov method, is described. The results of this approach, which is of more general validity than the tunnelling hamiltonian method, are shown to be expressible in terms of Feynman diagrams. Attention is drawn to the analogy between supercurrents and other processes involving phase coherence. (auth)

19727 THE MEASUREMENT OF THE REFRACTIVE INDEX OF LIQUID HYDROGEN. Belonogov, A. V.; Gorbunkov, V. M. (United Inst. for Nuclear Studies, Dubna, USSR). Cryogenics, 5: 315-19(Dec. 1965).

The optical and cryogenic systems of an apparatus for measuring the refractive index of liquid hydrogen in the temperature range 20–31°K are described. The deduction of the basic formula for calculating the value of n is given, and an analysis made of the accuracy of measurement. Results are given for measurements of n of normal- and para-hydrogen at three wavelengths. (auth)

19728 MAGNETIC SUSPENSION OF SUPERCONDUCTORS. Lazareva, L. V. Cryogenics, 5: 325-8(Dec. 1965).

The suspension of superconducting spheres in a magnetic field produced by different sources is studied experimentally. (auth)

19729 A BRASS THERMOMETER FOR USE IN DETERMINING TEMPERATURES BELOW 1 DEG K. Gordon, J. E. (Atomic Energy Research Establishment, Harwell, Eng.); Amstutz, L. I. Cryogenics, 5: 329-32(Dec. 1965).

Recent electrical and thermal conductivity measurements on brass (70% copper–30% zinc) indicate the suitability of this alloy for use as a primary standard in measuring temperatures in the region 0.3 to 0.7°K. It is estimated that absolute temperatures in this region can be measured with an uncertainty of a few millidegrees. The flexibility and simplicity of this method of determining absolute temperatures should make it useful for applications in which high precision magnetic thermometry is not necessary or possible. (auth)

19730 A HELIUM LIQUEFIER WITH LIQUID FLOW HEAT EXCHANGERS. Borovik, E. S.; Batrakov, B. P.; Kobzev, P. M. (Physico-Technical Inst., Academy of Sciences, USSR). Cryogenics, 5: 338-41(Dec. 1965).

The construction, operation, and performance of a helium liquifier with liquid flow heat exchangers is presented. (B.G.D.)

19731 SUPERCONDUCTING COILS COOLED BY A COLD FINGER. Levinson, P. (Coll. of France, Paris); Testard, O. Cryogenics, 5: 344-6(Dec. 1965).

The design and construction of a new cryostat for cooling super conducting coils is discussed. (B.G.D.)

19732 MICROSCOPY IN SUPERFLUID HELIUM. Conroy, J.; Gottlieb, M.; Garbuny, M. (Westinghouse Research Labs., Pittsburgh). Cryogenics, 5: 348-9 (Dec. 1965).

Problems encountered in the design of a microscope that will permit close examination of the surface of a metal immersed in liquid helium are presented. The construction of such a microscope is briefly discussed. (B.G.D.)

19733 MACROSCOPIC QUANTUM EFFECTS IN LIQUID HELIUM. Vinen, W. F. (Univ. of Birmingham, Eng.). Endeavour, 25: 3-7(Jan. 1966).

Quanta of energy are so small in size, and the permissible energy-levels so numerous, that macroscopic mechanical experiments normally do not show any effects explicable only by quantum mechanics. However, it is shown that there are conditions in which a substantial proportion of the atoms in a macroscopic quantity of liquid might be in the same quantum state; and a macroscopic mechanical experiment in which the consequences of this effect are directly observed is described. (auth)

19734 ON THE RELATIONSHIP BETWEEN SUPERCONDUCTIVITY AND THE COMMUNAL ENTROPY OF THE CRYSTAL STRUCTURE. Rajput, J. S.; Gupta, A. K. (Allahabad Univ., India). J. Phys. Soc. Jap., 21: 32-3 (Jan. 1966).

If the clear distance between two metal ions is plotted vs. the nearest neighbor distance an interesting fact is found that all the superconducting elements fall in a certain region of the plot. This region is called the island of superconductivity. It is postulated that the communal entropy of the metallic crystal structure due to sharing of the available volume by the metal ions, together with the valency of the elements, plays a prominent role in determining the occurrence of superconductivity. A number of known facts are discussed on this basis. (auth)

19735 EFFECT OF EXTERNAL CURRENT ON THE MAGNETIZATION OF NON-IDEAL TYPE II SUPERCONDUCTORS. Yasukochi, Ko (Nihon Univ., Tokyo); Ogasawara, Takeshi; Usui, Nobumitsu; Kobayashi, Hisayasu; Ushio, Shintaro. J. Phys. Soc. Jap., 21: 89-99(Jan. 1966).

The influence of the external current on the magnetization of nonideal type II superconductors is explained. It is shown how in the mixed state the external current brings about a particular state of the critical distribution of flux threads allowing a finite total transport current. In the case where the external current is perpendicular to the external magnetic field, the reduction of the magnetization due to the external current and its dependence on the history of the application of current and field are explained quantitatively in Nb–Zr(25%) alloy. The transverse paramagnetic effect observed by LeBlanc is also discussed. (auth)

19736 30-kG, 8 1/2-IN. BORE SUPERCONDUCTING COIL. Cornish, D. N. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Sci. Instrum., 42: 913-14 (Dec. 1965). (CLM-P-90).

A 30 kG, 8½ in. bore superconducting coil was designed using the minimum propagating current data obtained on a short length of composite superconductor. Tests on the coil show good agreement between predicted and actual performance. (auth)

19737 STUDY OF THE ELECTRICAL AND SUPERCONDUCTING PROPERTIES OF METALS WITH DIFFERENT PURITIES. Reich, Robert (Univ. Paris, Orsay, France). Mem. Sci. Rev. Met., 62: 869-920(Dec. 1965). (In French).

The variation of the electric resistivity at temperatures above the triple point of liquid hydrogen was measured. The ideal resistivity of aluminum, tin, gallium, and beryllium was studied. Scatter by the Matthiessen rule and change of this scatter with temperature were defined. (auth)

19738 LOSSES IN TYPE II SUPERCONDUCTORS BY VORTEX DISPLACEMENT. Baixeras, J.; Fournet, G. (LCIE, Fontenay-aux-Roses, France). Phys. Lett., 20: 226-8(Feb. 15, 1966). (In French).

Losses caused by the vortex displacement under the influence of a conduction current when the superconductor is placed in a magnetic field are calculated. These losses are caused by an electric field induced by the vortex displacement. The field acts on the normal electrons bringing about the losses. (J.F.P.)

19739 THE MAGNETIC FIELD DEPENDENCE OF THE 2Δ/n STRUCTURE OBSERVED IN Pb-PbO-Pb SUPERCON-

DUCTING TUNNELING JUNCTIONS. Marcus, S. M. (E. I. Du Pont de Nemours and Co., Wilmington, Del.). Phys. Lett., 20: 236-7(Feb. 15, 1966).

Magnetic field dependence of structure centered at voltages $2\Delta/n$ in superconducting Pb-PbO-Pb tunneling junctions was investigated. This field dependence indicates this structure is caused by a tunneling process occurring in regions of the junction where there are metallic filaments. (auth)

19740 A NONLOCAL THEORY FOR THE SUPERCONDUCTOR IN A MAGNETIC FIELD. Schattke, W. (Univ., Kiel). Phys. Lett., 20: 245-7(Feb. 15, 1966).

A gauge-invariant, nonlocal generalization of the Ginzburg-Landau equations is derived from the BCS theory assuming small magnetic fields and relative variations of the order parameter. There is no restriction to slowly varying fields. (auth)

19741 INTRINSIC PROPERTIES OF HYSTERESIS LOOPS OF SUPERCONDUCTORS. Schweitzer, D. G.; Bertman, B. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett., 20: 263-4(Feb. 15, 1966). (BNL-9806).

Properties of certain hysteresis loops not previously described and which seem to be common to all superconductors are given. These results are summarized from investigations of triply zone refined niobium, chemically pure lead, solid-solution homogeneous alloy systems, and inhomogeneous alloy systems. The properties of the hysteresis loops described are independent of the homogeneity and chemical nature of the systems and previous magnetic field history. These generalizations for all hysteretic superconductors are listed. (J.F.P.)

19742 EXPERIMENTAL EVIDENCE FOR THE SURFACE NATURE OF a-c LOSSES IN TYPE II SUPERCONDUCTORS. Easson, R. M.; Hlawiczka, P. (Univ. of Glasgow). Phys. Lett., 20: 33-4(Mar. 1, 1966).

A-c losses measured on ring shaped samples of lead bismuth depend only on the surface current density, on the assumption of an exponential current distribution. (auth)

19743 RESISTANCE IN THE INTERMEDIATE STATE OF TYPE I SUPERCONDUCTORS. Chandrasekhar, B. S.; Dinewitz, I. J.; Farrell, D. E. (Western Reserve Univ., Cleveland). Phys. Lett., 20: 321-2(Mar. 1, 1966).

It was recently suggested that the potential difference observed in the intermediate state is due to the motion of vortices. The conditions under which such voltages can appear in type-I materials are discussed. (auth)

19744 RECOMBINATION EFFECTS ON ELECTRON TUNNELING INTO SUPERCONDUCTING LEAD. Khanna, S. M.; Woods, S. B. (Univ. of Alberta, Edmonton, Can.). Phys. Lett., 20: 335-6(Mar. 1, 1966).

A new structure caused by recombination processes in the normalized dynamic conductance of an aluminum-aluminum oxide-lead tunnel junction, as predicted earlier, was observed at temperatures just below the superconducting transition temperature of lead. (auth)

19745 EVIDENCE OF THE INSTABILITY OF FLUX GRADIENTS IN IRREVERSIBLE SUPERCONDUCTORS. Schweitzer, D. G.; Bertman, B. (Brookhaven National Lab., Upton, N. Y.). Phys. Lett., 20: 339-40(Mar. 1, 1966). (BNL-9777).

It is shown that the internal field gradients present during the initial magnetization of an "irreversible" superconductor are to a great extent, and in some cases completely, destroyed when the external field is removed and reapplied. (auth)

19746 ON THE ELECTRIC FIELDS IN FLUX TUBES AND CURRENT VORTICES IN TYPE 1 AND TYPE 2 SUPERCONDUCTORS. Park, J. G. (Imperial Coll. of Science and Tech., London). Phys. Lett., 20: 346-8 (Mar. 1, 1966).

A simple analysis is given of the effect of the motion of current vortices in superconductors. (auth)

19747 DISSIPATION IN TYPE-II SUPERCONDUCTORS VIA THE a-c JOSEPHSON EFFECT. Schwartz, B. B. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 20: 350-1(Mar. 1, 1966).

The core electric field in moving vortices is obtained from the a-c Josephson effect. The uniformity of this field is consistent only with one flux quantum per vortex. Radiation is expected at frequency $2v_L/\xi$, where v_L is the vortex line velocity. (auth)

19748 DELAYED FLUX ENTRY INTO TYPE II SUPERCONDUCTORS. Fink, H. J. (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Phys. Lett., 20: 356-7(Mar. 1, 1966).

The maximum field H_s to which flux may be delayed from entering the Meissner state of a type-II superconductor is the thermodynamic critical field H_c for all appropriate Ginzburg-Landau κ-values provided the sample is very large compared to the coherence length ξ. (auth)

19749 SURFACE EFFECT AND ANOMALOUS RESISTIVE TRANSITIONS IN Pb. Kao, Yi-han (State Univ. of New York, Stony Brook). Phys. Lett., 20: 360-2(Mar. 1, 1966).

Resistive transitions in Pb films (4.6×10^{-4} cm thick) were studied at 4.2°K with different measuring currents and various orientation of a transverse magnetic field. Surface superconductivity and an anomalous transition behavior were observed. (auth)

19750 DISCONTINUITY OF THE DENSITY OF ROTATING LIQUID HELIUM AT THE POINT OF THE PHASE TRANSITION. Andronikashvili, E. L.; Tsakadze, J. S. (Inst. of Physics, Academy of Sciences Georgian SSR). Phys. Lett., 20: 446-8(Mar. 15, 1966).

It is shown that the density of rotating liquid helium, in contrast to the density of the liquid at rest, has a discontinuity at the point of the phase transition HeII–HeI. (auth)

19751 LOW-TEMPERATURE SPECIFIC HEATS OF UNANNEALED NIOBIUM WIRES IN MAGNETIC FIELDS. Ferreira Da Silva, J.; Van Duykeren, N. W. J.; Dokoupil, Z. (Kamerlingh Onnes Lab., Leiden). Phys. Lett., 20: 448-9 (Mar. 15, 1966).

Specific heats of a bundle of unannealed niobium wires were measured at different magnetic fields. Emphasis is given to the mixed superconductive state at temperatures much below the transition temperature T_c, as well as to the temperature dependence of the specific heat jump at the transition from the mixed to the normal state. (auth)

19752 INTRINSIC HYSTERESIS IN A COPPER-PLATED TYPE II SUPERCONDUCTOR. Gittleman, J. I.; Rosenblum, B. (RCA Labs., Princeton, N. J.). Phys. Lett., 20: 453-5(Mar. 15, 1966).

Reversal in "intrinsic" hysteresis in microwave surface resistance occurs in copper plated, $Pb_{0.83}$-$In_{0.17}$. This is interpreted in terms of magnetic and order parameter forces at the surface. These forces at inhomogeneities determine flux pinning. (auth)

19753 THERMAL NATURE OF THE a-c PHASE TRANSITION IN TYPE II SUPERCONDUCTORS. Easson, R. M.; Hlawiczka, P.; Ross, J. M. (Univ. of Glasgow). Phys. Lett., 20: 465-6(Mar. 15, 1966).

Experiments are described which demonstrate that the superconducting to normal transition in Type II superconductors is caused by a temperature rise above T_c due to a-c losses, rather than by the peak a-c currents rising to the thermodynamic critical value. (auth)

19754 MEASUREMENT OF PROXIMITY EFFECTS IN Ag FILMS BY MEANS OF TUNNELING. Marcus, S. M. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Lett., 20: 467-9(Mar. 15, 1966).

The induced superconductivity energy gap, Δ_{Ag}, of Ag films caused by the proximity of a Pb film was measured by tunneling. Δ_{Ag} decreases exponentially with increased Ag thickness and is independent of applied magnetic field below a critical value. (auth)

19755 THE DEPENDENCE OF THE CRITICAL VELOCITY OF THE SUPERFLUID ON CHANNEL DIAMETER AND FILM THICKNESS. Van Alphen, W. M.; Van Haasteren, G. J.; De Bruyn Ouboter, R.; Taconis, K. W. (Kamerlingh Onnes Lab., Leiden). Phys. Lett., 20: 474-5(Mar. 15, 1966).

The superfluid critical velocity in liquid helium varies with the fourth root of the diameter, ranging from a few Å up to a few cm. The quasi "critical" velocities often found are due to the onset of classical turbulence. (auth)

19756 NUCLEAR PARAMAGNETISM OF ^{3}He–^{4}He SOLUTIONS ABOVE 0.9 DEG K. Schwettman, H. A.; Rorschach, H. E. Jr. (Rice Univ., Houston, Tex.). Phys. Rev., 144: 133-40(Apr. 8, 1966).

The temperature dependence of the nuclear susceptibility of pure ^{3}He and ^{3}He–^{4}He mixtures ^{3}He concentrations 0.81, 0.70, 0.38, and 0.14 was determined with an accuracy of ±1% for $0.92 < T < 2.9$°K. This work is an extension of that of Fairbank, Ard, and Walters, and shows that within experimental error the temperature dependence for the solutions is the same as that of the pure liquid. The maximum deviation of the susceptibilities from an inverse temperature dependence is approximately 5%. These results indicate that the susceptibility is insensitive to the average separation of the ^{3}He atoms, contrary to the behavior that might be expected from a Fermi system in which exchange is important. A perturbation calculation, however, suggests that such behavior can be understood as a near cancellation of terms arising from the exclusion principle and the exchange interaction. (auth)

19757 HEAT CAPACITY AND OTHER PROPERTIES OF BODY-CENTERED CUBIC ^{4}He. Edwards, D. O.; Pandorf, R. C. (Ohio State Univ., Columbus). Phys. Rev., 144: 143-51(Apr. 8, 1966).

The heat capacity at constant volume, C_v, of bcc ^{4}He was measured for a number of molar volumes covering most of the bcc region of the phase diagram. The results can be represented to within 3% of C_V by a constant Debye Θ of 16.95°K. Using the discontinuities in the heat capacity at the phase boundaries measured in this and in previous work, the compressibility κ is found to be $(3.8 \pm 0.2) \times 10^{-3}$ atm^{-1} and substantially independent of temperature, while values of the expansion coefficient α found by the same method are between 5×10^{-3} and 13×10^{-3} deg^{-1}. The values of α are consistent with a Gruneisen equation with a Gruneisen constant $\gamma \approx 2.6$, the value found previously for hcp ^{4}He. The latent heats at constant volume at the lower and upper triple points T_1 and T_2 were measured as a function of volume and give for the maximum entropy change at T_1, where (hcp + liq) → (bcc), the value $\Delta S_1/R = (9 \pm 1) \times 10^{-3}$. The maximum entropy change at T_2, where bcc → (hcp + liq), has the value $\Delta S_2/R = (32 \pm 2) \times 10^{-3}$. The triple-point temperatures were found to be $T_1 = 1.463 \pm 0.002$°K and $T_2 = 1.7715 \pm 0.001$°K. The intersection of the λ line with the bcc phase boundary was confirmed to be ~10 mdeg below the upper triple point. The entropy of the bcc phase at the transition line was computed from the heat-capacity results and the latent-heat measurements, and is found to vary from $S/R = 0.037 \pm 0.002$ at T_1 to $S/R = 0.068 \pm 0.003$ at T_2. The relation between S and C_v is the same as for the other low-pressure structures of solid ^{3}He and ^{4}He, indicating that the variation of Θ with T and therefore the lattice spectra are similar. On the supposition that bcc ^{4}He is indeed like the other forms of solid helium, it is estimated that bcc ^{4}He would have a Debye Θ at 0°K, Θ_0, of 21°K for a molar volume of 21 cm^3. This value of Θ_0, when compared with the measured velocity of sound, indicates that bcc ^{4}He is elastically highly anisotropic, in agreement with the recent theory of Nosanow and Werthamer. (auth)

19758 THEORY OF LIQUID HELIUM II IN A ROTATING ANNULUS: GINZBURG-PITAEVSKII APPROACH. Bennett, Alan J.; Falicov, L. M. (Univ. of Chicago). Phys. Rev., 144: 162-5(Apr. 8, 1966).

The Ginzburg-Pitaevskii two-fluid formulation of the superfluidity problem is used to describe the behavior of He II in a rotating annular cylinder. The equations are solved with the assumption that the thickness of the annulus is (a) much smaller than the mean radius and (b) much larger than the superfluid healing length. Two cases are considered: (i) constant angular velocity, (ii) constant angular momentum. Curves are given for the free energy and the superfluid-component density as a function of angular velocity or angular momentum. (auth)

19759 MELTING PRESSURE AND α-γ SOLID-PHASE TRANSFORMATION OF ^{4}He NEAR THE UPPER LAMBDA POINT. Kierstead, Henry A. (Argonne National Lab., Ill.). Phys. Rev., 144: 166-9(Apr. 8, 1966).

Measurements are reported of the slope $(dP/dT)_m$ of the melting curve of ^{4}He over the temperature range -3×10^{-3}°K $< T - T_{\lambda'} < 15 \times 10^{-3}$°K for the γ solid phase and 9×10^{-3}°K $< T - T_{\lambda'} < 19 \times 10^{-3}$°K for the α solid phase, where $T_{\lambda'}$ is the temperature of the upper lambda point. The upper triple point, where the two solid phases and the liquid are in equilibrium, is $(10.00 \pm 0.10) \times 10^{-3}$°K and 0.305 ± 0.003 atm above the upper lambda point. The slope of the α-γ transition line at the triple point is 14.3 ± 0.7 atm/°K. The temperature and pressure of the upper lambda point are 1.7632 ± 0.0001°K and 29.83 ± 0.02 atm, respectively, in satisfactory agreement with earlier measurements. (auth)

19760 CLASSICAL AND QUANTUM-MECHANICAL TURBULENCE IN He II HEAT FLOW. Tough, J. T. (Ohio State Univ., Columbus). Phys. Rev., 144: 186-95(Apr. 8, 1966).

The theory of the He II thermal counterflow process in wide ($d > 10^{-3}$ cm) channels is investigated on the assumption that both the normal and superfluid components make a transition from a laminar to a turbulent type of flow. A critical heat current W_0 is identified with the superfluid transition. The superfluid turbulent state is taken to be essentially that described by Vinen in terms of quantized vortex line and has an associated mutual friction. A second critical heat current W_c is identified with the normal-fluid transition. It is argued that this transition is essentially of a classical turbulent type, with the added condition that the critical value of the Reynolds number must depend on the extent of mutual-friction coupling. This interpretation is shown to be consistent with experimentally observed critical heat currents, as well as with critical-velocity effects found in other types of flow. The assumption of two critical heat currents defines three distinct flow regions. It is shown that these three regions are essentially the same as those found experimentally by Allen, Griffiths, and Osborne. On the basis of some simplifying assumptions regarding the normal-fluid turbulent state, the temperature and pressure gradients accompanying thermal counterflow are calculated. Comparison with experiment shows good qualitative and often quantitative agreement. It is also shown that the model developed can be successfully used to interpret experiments involving flows of a nonthermal counterflow type. (auth)

19761 HEAT CURRENTS IN LIQUID HELIUM II. Vicentini-Missoni, M.; Cunsolo, S. (Univ., Rome). Phys. Rev., 144: 196-206(Apr. 8, 1966).

Measurements on the deflection of a beam of negative ions due to a counterflow of superfluid and normal fluid in He II show the existence of two thresholds for the velocity. The first one is interpreted as the critical velocity for creation of vorticity in the superfluid, while it is suggested that the second threshold corresponds to instability of the whole fluid with respect to turbulence. Measurements on the positive ions reveal the behavior of the normal-fluid velocity; when there is vorticity in the superfluid, these results indicate the existence of a normal-fluid velocity gradient in the flow direction. Parallel measurements on the temperature distribution show nonuniformity of the temperature gradient in the flow direction for large velocities. The assumptions on which the Gorter-Mellink expression for the mutual friction force is derived are not satisfied. The results are then interpreted as an indication that the higher order terms in the equations of motions may give instability at large velocities. (auth)

19762 PRESSURE DEPENDENCE OF THE SUPERCONDUCTING TRANSITION TEMPERATURE OF VANADIUM AND NIOBIUM. **Gardner, W. E. (Atomic Energy Research Establishment, Harwell, Eng.); Smith, T. F. Phys. Rev., 144: 233-6(Apr. 8, 1966).**

The pressure dependence of the superconducting transition temperature T_c of vanadium ($\partial T_c/\partial P = 11 \pm 3 \times 10^{-6}$ °K bar^{-1}) and niobium ($\partial T_c/\partial P = 0 \pm 3 \times 10^{-6}$ °K bar^{-1}) was studied up to a maximum pressure of 10 kbar. The observed values are compared with values calculated from calorimetric and thermal-expansion data. A possible explanation of the observed variation in the sign of the pressure dependence of T_c in the transition-metal superconductors is offered. (auth)

19763 THERMAL CONDUCTIVITY DUE TO IMPURITY SCATTERING FOR SUPERCONDUCTORS WITH OVERLAPPING BANDS. **Vasudevan, R.; Sung, C. C. (Univ. of California, Berkeley). Phys. Rev., 144: 237-9(Apr. 8, 1966).**

Calculations of thermal conductivity due to impurity scattering for BCS-type superconductors carried out by Bardeen, Rickayzen, and Tewordt (BRT) are extended to the case of the two-spherical-band model proposed by Suhl, Mathias, and Walker using some of the results obtained recently by Sung and Shen concerning the specific heat of such superconductors. The curve obtained for the ratio of thermal conductivities in the superconducting and the normal state, which is valid near the transition temperature, yields values lower than the corresponding results obtained by BRT. This is caused by the lowering of the mean free path of the excitations occasioned by the possibility of intraband scattering. (auth)

19764 ELECTRONIC STRUCTURE AND SUPERCONDUCTIVITY OF INDIUM–CADMIUM ALLOYS. **Merriam, M. F. (Univ. of California, San Diego, La Jolla). Phys. Rev., 144: 300-8(Apr. 8, 1966).**

The superconducting transition temperatures (in zero magnetic field) of In–Cd alloys in the range 0–60 at. % cadmium were measured. T_c decreases from 3.406 to 3.245°K in the tetragonal solid solution and from 3.55 to 3.00°K in the cubic phase, with increasing Cd content. A kink in the T_c-versus-composition curve at 2 at. % Cd is attributed to Fermi-surface-Brillouin-zone interaction. This interpretation is supported by lattice-parameter determinations, which show an anomaly at 2% Cd, and also by the magnetic susceptibility measurements of Verkin and Svechkarev. The existence of the superconductivity anomaly at Z = 2.98 supports a recent hypothesis of Svechkarev concerning the electronic structure of indium. Measurement of reduced resistance ratio $\rho \equiv R_{4.2°}/(R_{273°} - R_{4.2°})$ show ρ to be linear in Cd concentration x up to the solubility limit at 5 at. % Cd, with a slope of 0.042/(at. % Cd). The data for the tetragonal phase are not linear on a plot of $\Delta T_c/x$ versus Inx, and thus do not fit the present theory of T_c variation in primary solid solutions. At the tetragonal-cubic phase transition, T_c jumps by 10% without change of electron/atom ratio, cell volume, or ionic mass. The superconductivity data are all consistent with the published phase diagram of Heumann and Predel. (auth)

19765 MECHANICAL FORCES ON A SUPERCONDUCTING FILM. **Houston, W. V.; Smith, David R. (Rice Univ., Houston, Tex.). Phys. Rev. Lett., 16: 516-17(Mar. 21, 1966).**

The mechanical forces on a superconducting tin film in a magnetic field perpendicular to the film surface were studied by means of a torsion pendulum. (G.O.Y)

19766 ANOMALOUS ULTRASONIC ATTENUATION IN PURE SUPERCONDUCTING Pb. **Deaton, B. C. (General Dynamics, Fort Worth, Tex.). Phys. Rev. Lett., 16: 577-9 (Mar. 28, 1966).**

Observations of an apparent unrelated anomaly in the ultrasonic attenuation of compressional waves in high-purity Pb single crystals at low temperatures are discussed. Measurements using the Pb crystals reveal a striking frequency dependence of the shape of the normalized ultrasonic attenuation curves in the superconducting state. An explanation is suggested in terms of similar deviations from theory in the thermal conductivity of superconducting Pb. (B.G.D.)

19767 SUPERCONDUCTIVITY IN CERAMIC, MIXED TITANATES. **Frederikse, H. P. R.; Schooley, J. F.; Thurber, W. R.; Pfeiffer, E.; Hosler, W. R. (National Bureau of Standards, Washington, D. C.). Phys. Rev. Lett., 16: 579-81(Mar. 28, 1966).**

The superconducting transition temperature in ceramic samples of mixed titanate semi conductors and the parameters affecting it are experimentally investigated. These parameters include electron-phonon interactions, the effective mass of the charge carriers, and the dielectric function. (B.G.D.)

19768 CORRELATION OF DENSITY FLUCTUATIONS IN A SUPERFLUID. **Boers, A. (Univ. of St. Andrews, Scotland). Proc. Phys. Soc. (London), 87: 343-7(Feb. 1966).**

The expectation value $\langle\rho(x)\rho(y)\rangle$ of the pair density operator is calculated for a dilute Bose system in which the excitations move with drift velocity u with respect to the free-particle ground state. In general $\langle\rho(x)\rho(y)\rangle - \langle\rho\rangle^2$ depends on the drift velocity u and the angle ψ between u and $r = x - y$. For very large r, $\langle\rho(x)\rho(y)\rangle - \langle\rho\rangle^2$ is found to vanish as r^{-4}, and to become practically independent of u and ψ. (auth)

19769 CRYOSTAT FOR NEUTRON DIFFRACTION STUDIES BETWEEN LIQUID HELIUM TEMPERATURES AND ROOM TEMPERATURE. **Sparks, Joseph T.; Komoto, Ted; Wade, William R. (Univ. of California, Livermore). Rev. Sci. Instrum., 37: 435-8(Apr. 1966). (UCRL-12179).**

An efficient all metal cryostat is described for temperature dependent neutron diffraction studies in the range of liquid helium temperatures to room temperature. A modification of the Swenson type heat exchanger is employed in which the temperature is controlled by regulating the flow of cold gas or liquid through the exchanger by means of a precision needle valve. Using liquid helium in the system, sample temperatures in the range 2 to 100°K can be obtained. For fixed settings of the needle valve in the range for 4.2 to 40°K, the long term temperature drifts are less than 0.01°K/h. The short term periodic fluctuations are on the order of ±0.1°K or less. On one filling of liquid helium, the sample can be maintained for 2 days at any given temperature from just above the boiling point of helium up to about 100°K with an average loss rate of 25 cc of liquid per hour. The loss rate increases to about 45 cc/h when the sample is held at 4.2°K. Using liquid nitrogen in place of liquid helium in the temperature control system, sample temperatures between 77°K and room temperature may be obtained. (auth)

19770 MACROSCOPIC QUANTUM EFFECTS IN SUPERCONDUCTING RINGS INTERRUPTED BY INSULATING JUNCTIONS [Thesis]. **Goldman, Allen Marshall. Stanford, Calif., Stanford Univ., 1965. 121p.**

Mercereau has shown that the long range order that characterizes the superconducting state extends all the way around a ring containing insulating junctions. He observed that the critical supercurrent through two insulating junctions connected in parallel was periodic in the applied magnetic field. Mercereau's experiment was repeated, and it was further demonstrated that the zero-voltage current through insulating layers is indeed a zero-resistance current. Two levels of quantized persistent currents were seen in a ring containing two insulating junctions. The magnetic field dependence of the critical supercurrent of the parallel combination of the same junctions was measured and the current-voltage characteristic of this configuration was observed. The results indicated that the two junctions were indeed insulating. Higher persistent current levels than the second were momentarily trapped, but always appeared to decay to the second level. The first two levels were monitored for one-half hour without any noticeable change in the value of the flux trapped. The ex-

periment of Zimmerman and Silver was repeated, indicating that the critical supercurrent of two filamentary shorts connected in parallel in a superconducting ring, is periodic in the applied magnetic field. In addition, a detailed study was made of the current-voltage characteristics of structures of this type in the presence of applied magnetic fields. The current-voltage characteristics of samples containing two Josephson junctions in a lead ring were plotted using d-c and audio techniques. The maximum zero voltage currents of these junctions increased by a factor of three going from d-c to 5 cps at temperatures below 3°K and appeared to increase with audio sweep frequency up to 100 cps. The excess supercurrent was unstable with respect to transitions to the single-particle tunneling curve, indicating that finite lifetime processes are contributing to the tunnel current at zero voltage. (A.G.W.)

19771 THE MEASUREMENT OF THE LONDON MOMENT [Thesis]. Bol, Morris. Stanford, Calif., Stanford Univ., 1965. 59p.

The experimental verification of a prediction by F. London that a rotating superconductor produces a magnetic moment, which depends only upon the state of rotation of the superconductor and which is independent of the initial conditions is presented. The predicted effect is given by the equation $H = (2mc/e)\omega$. The result is derived from London's macroscopic equations, and is compared with zero resistance theory. The experiment confirmed London's prediction within experimental error. Measurements were successfully made using a mercury sample 0.106″ in diameter and ½″ long. The mercury was contained in a beryllium-copper and aluminum container, to which was connected a 0.010″ diameter tungsten wire coupled to a magnetically shielded room-temperature drive motor. The magnetic moment was detected by means of a pair of pickup coils vibrating about the end of the sample. The apparatus and method are described in detail. An application of the London moment to detect the precession of a gyroscope prediction by Einstein's theory of general relativity is described along with another technique employing the Mössbauer effect. A circuit for detecting small magnetic fields was developed and is described. This circuit may be used to measure the general relativity precession of a gyro in conjunction with the London moment. (Dissertation Abstr.)

19772 TRANSMISSION AND REFLECTION COEFFICIENTS OF THIN SUPERCONDUCTING FILMS [Thesis]. Rugheimer, Norman MacGregor. Chapel Hill, N. C., Univ. of North Carolina, 1965. 127p.

Thin films were placed directly across a waveguide that ran straight through a metal cryostat. Transmission and reflection coefficients were measured as a function of temperature for both tin films and indium films in the frequency ranges 22-24 and 27-35 Gc/sec. The results are compared to theoretical transmission and reflection coefficients calculated from the complex conductivities derived by Mattis and Bardeen. Some very thin films had negative temperature coefficients of resistance. These films had current-voltage characteristics similar to those seen in superconducting tunneling experiments with the abscissa scaled to volts rather than millivolts indicating many barriers rather than a single barrier. Although these films were believed to be composed of many islands of metal, they appeared continuous when viewed through an oil emersion microscope. Some observed data indicated the possibility of states in the Bardeen-Cooper-Schrieffer gap. In order to see how states in the gap might affect the experimental data, some values of the integrand determining the complex conductivities were plotted. As the microwave energies in the experiments were only about one-tenth the gap energy at absolute zero, only states lying near the upper edge of the gap would be detected. (Dissertation Abstr.)

19773 SUPERCONDUCTIVITY OF METALS AND ALLOYS. de Gennes, P. G. Frontiers in Physics. New York, W. A. Benjamin, Inc., 1966. 288p.

Translated by P. A. Pincus.

An elementary discussion of magnetic properties of type-I and type-II superconductors is given. The microscopic theory is developed using Bogoliubov self-consistent fields The properties of alloys, including dirty alloys and pure metals, are discussed. The topics presented are the fundamental properties of superconductors, magnetic properties of the first and second kinds, the condensed state, the self-consistent field method, phenomenological Landau-Ginsburg equations, a microscopic analysis of these equations, and the effects of strong magnetic fields and magnetic impurities. (J.F.P.)

19774 LOW TEMPERATURE PHYSICS. LT9. PART A. Proceedings of the IXth International Conference, Columbus, Ohio, August 31–September 4, 1964. Daunt, J. G., Edwards, D. O.; Milford, F. J.; Yaqub, M. (eds.). New York, Plenum Press, 1965. pp 1-620. $19.50. (CONF-651(Pt.A)).

This section of the conference on low temperature physics contains discussions on superfluidity, quantization and vortices in superconductors and liquid helium, quantum liquids, and helium, which includes second sound, rotation, vortices, films, solid helium, solid helium with isotopic mixtures, superfluid-flow critical velocities, and turbulence, also ions in liquid helium, and adsorbed helium-3. Superconductivity, including ultrasonics, microwaves, tunneling, quantized flux, rotating superconductors, superconducting transition, thermal phenomena, type-II superconductors, thin films, and superconducting materials, is also covered. Abstract numbers for papers previously abstracted in NSA appear in the Report Number Index under CONF-651. (J.F.P.)

19775 LOW TEMPERATURE PHYSICS. LT9. PART B. Proceedings of the IXth International Conference, Columbus, Ohio, August 31–September 4, 1964. Daunt, J. G.; Edwards, D. O.; Milford, F. J.; Yaqub, M. (eds.). New York, Plenum Press, 1965. pp 621-1255. $19.50. (CONF-651(Pt.B)).

The second section of the conference on low temperature physics treats low-temperature transitions, and Fermi surfaces, covering magnetoresistance cyclotron resonance, the de Haas-van Alphen effect, acoustic absorption, transport phenomena, size effects, and magnetic breakdown. Magnetism and dilute alloys including magnetic scattering, localized moments, hyperfine splitting, and other magnetic phenomena, electric resistivity, thermoelectric power, and electronic specific heat are discussed. Rare gas solids, solid hydrogen and methane, specific heat, phonon scattering, ionic solids, metals at low temperatures, liquid and gaseous hydrogen, and techniques are considered. Abstract numbers for papers previously abstracted in NSA appear in the Report Number Index under CONF-651. (J.F.P.)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies

Refer also to abstracts 20101, 20170, 20218, and 20331.

19776 (AE-223) NEUTRON SCATTERING IN HYDROGENOUS MODERATORS, STUDIED BY TIME-DEPENDENT REACTION RATE METHOD. Larsson, L. G.; Moeller, E.; Purohit, S. N. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1966. 26p. Dep. mn.

The moderation and absorption of a neutron burst in water, poisoned with the non-1/v absorbers cadmium and gadolinium, was followed on the time scale by multigroup calculations, using scattering kernels for the proton gas and the Nelkin model. The time dependent reaction rate curves for each absorber display clear differences for the two models, and the separation between the curves does not depend much on the absorber concentration. An experimental method for the measurement of infinite medium reaction rate curves in a limited geometry was investigated. This method makes the measurement of the time dependent reaction rate generally useful for thermalization studies in a

small geometry of a liquid hydrogenous moderator, provided that the experiment is coupled to programs for the calculation of scattering kernels and time dependent neutron spectra. Good agreement was found between the reaction rate curve, measured with cadmium in water, and a calculated curve, where the Haywood kernel was used. (auth)

19777 (CEA-R-2923) RESOLUTION DE L'EQUATION MULTIGROUPE DE LA DIFFUSION DANS UNE GEOMETRIE A UNE DIMENSION ET CALCULS ANNEXES: CODE MUDE. (Solution of Multigroup Diffusion Equation in a One-Dimensional Geometry and Subsidiary Calculations: the MUDE Code). Bore, Claude; Dandeu, Yves; Saint-Amand, Chantal (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec. 1965. 193p. Dep. mn.

The computer program MUDE, which solves a system of difference equations approximating the one-dimensional multigroup diffusion equation, is described. The program is written in FORTRAN II for the IBM 7090-7094. (D.C.W.)

19778 (GA-6824) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1964-September 30, 1965. Beyster, J. R.; Antunez, H.; Brouwer, W.; (and others) (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Nov. 1, 1965. Contract AT(04-3)-167. 230p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Results of research in the following areas are presented: neutron thermalization in H_2O, D_2O, polyethylene, zirconium hydride, beryllium, and beryllium oxide; fast reactor studies; neutron spectra in heterogeneous assemblies; experimental and calculational techniques; universal scattering law code; neutron spectra book; and research facilities. (M.O.W.)

19779 (GA-6904) RECENT DEVELOPMENTS IN INTEGRAL NEUTRON THERMALIZATION. Beyster, J. R.; Neill, J. M.; Young, J. C. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Feb. 2, 1966. Contract AT(04-3)-167. 44p. (CONF-660204-5). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Nuclear Society Meeting, San Diego, Calif.

A summary of integral neutron thermalization studies at General Atomic is presented; particularly the measurements of neutron spectra, total cross sections, and angular scattering cross sections. (M.O.W.)

19780 (JAERI-1094) MANUAL OF EGELSTAFF-SCHOFIELD MODEL CODE (E. S. CODE). Ken-Masuoka; Arai, Kimio (Japan Atomic Energy Research Inst., Tokyo). Dec. 1964. 18p. (In Japanese). Dep. mn.

The ES-code is an IBM-7090 FORTRAN program based on the method of Egelstaff-Schofield for calculating scattering laws, scattering kernels and their Legendre moments, and thermal neutron sources from the slowing down region. Making use of the experimental values of frequency distributions for bounded motions, energy levels of molecular vibrations and parameters of diffusive motions, one can take into consideration the effects of lattice vibrations of crystals, internal vibrations of molecules, and diffusive motions of molecules in liquids. This code is applicable to both liquid and solid moderators. The programming is carried out only for incoherent scatterings. (auth)

19781 (JAERI-1095) THEORETICAL CALCULATION FOR THERMAL NEUTRON SCATTERING KERNEL. (Japan Atomic Energy Research Inst., Tokyo). Dec. 1964. 34p. (In Japanese). Dep. mn.

Various theoretical models were developed to analyze the effect of chemical binding on neutron scattering cross sections. The Thermal Neutron Group in the Japanese Sigma Committee has engaged in preparing the codes for these models. The codes named FREE, NELKER, E.S. and UNCLE were made for the Free Gas Model, the Nelkin's Model, the Egelstaff-Schofield's Model and the model for the anisotropic crystalline, respectively. The numerical results of the scattering law and scattering cross section for moderator materials, calculated by these codes, are compared with the experimental data. (auth)

19782 (LA-3374) HYDRO—A SMALL, WATER-COOLED, AND WATER-REFLECTED NEUTRON SOURCE. Bernard, William (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 1965. Contract W-7405-eng-36. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A remotely controlled, portable critical assembly that uses enriched uranium metal is described. The operation of the assembly is discussed briefly together with some applications of the assembly. (D.C.W.)

19783 (NAA-SR-10951) DTF-II—A ONE-DIMENSIONAL, MULTIGROUP NEUTRON TRANSPORT PROGRAM. Engle, W. W.; Boling, M. A.; Colston, B. W. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT-11-1-GEN-8. 103p. Dep. mn. CFSTI $2.45 cy, $0.75 mn.

The computer program DTF-II, which solves the multigroup one-dimensional neutron transport equation for either cylindrical, slab, or spherical geometries using the discrete s_n approximation, is described. The program is written in FORTRAN II for the IBM 7090/7094 computers. (D.C.W.)

19784 (NAA-SR-11530) THE CALCULATION OF SLOWING-DOWN TRANSFER MATRICES IN THE SPHERICAL HARMONICS REPRESENTATION. O'Reilly, Bruce D.; Lewis, Richard C. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT(11-1)-Gen-8. 74p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The calculation of transfer matrices for use in multigroup spherical harmonics calculations is discussed. The defining equations are derived from considering the slowing-down source of neutrons in the spherical harmonics representation. Both elastic and inelastic scattering processes are accounted for. Two complementary procedures are used to calculate the matrix elements for inelastic scattering: (1) the discrete level model, and (2) the Weisskopf evaporation model. Elastic scattering is accounted for by the discrete level model with zero threshold energy. Particular attention was given to describing the differential angle-energy cross section for neutrons exciting a discrete energy level of the target nucleus. The usually neglected double-valued relation between incident and emergent energies in the laboratory frame, which exists when the incident energy approaches closely to the threshold energy, is taken into account. Neutron balance conditions are found for the group-averaged slowing-down current and for the group averages of the higher-ordered Legendre coefficients of the slowing-down distribution, as well as the usual balance condition for the scalar slowing-down flux. It is found that the transitions of neutrons incident in the double-valued region contribute negligibly to the overall neutron balance. A sample calculation of the P_0-matrix for ^{12}C in a 16-group structure is also given. The sample calculation is carefully analyzed with respect to the effects of numerical approximations on the accuracy of computed matrix elements. A number of numerical procedures are recommended for improving the accuracy of transfer matrix calculations. Methods are discussed for obtaining estimates of spectra appropriate to critical reactors, reactor kinetics, and shields. (auth)

19785 (RISO-118) NUMERICAL ANALYSIS OF CRITICAL NEUTRON SCATTERING DATA. Nielsen, Peter (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Oct. 1965. 18p. Dep. mn.

A brief description is given of the method used to derive numerical information concerning the space and time dependence of correlation functions from data obtained in critical magnetic scattering experiments. Although the treatment concentrates on the case of iron, many features of the analysis are generally applicable. (auth)

19786 (WAPD-T-1835(Rev.)) MONTE CARLO METHODS FOR THE CALCULATION OF THERMAL NEUTRON FLUXES. Gelbard, E. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT(11-1)-Gen-14. 20p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Monte Carlo codes for calculating thermal-neutron fluxes are discussed. Some of the methods that are used to treat specific problems are outlined. (D.C.W.)

19787 A DOUBLE CURVED NEUTRON CONDUCTOR FOR SUPPRESSION OF THE HIGHER ORDER IN NEUTRON DIFFRACTION EXPERIMENTS. Schmatz, W. (Institut fuer Neutronenphysik der KFA, Juelich, Ger.). Acta Crystallogr., 20: 311-12(Feb. 10, 1966). (In German).

A neutron guide consisting of two oppositely curved components with a simple direct line of sight is described. The transmission of the guide averaged over the cross section was calculated and is shown graphically. The doubly curved guide completely suppresses the second order in neutron diffraction. (J.S.R.)

19788 ON THE PROBLEM OF DETERMINING NEUTRON FIELDS IN TIME-DEPENDENT MEDIA. [PART] I. Barz, H.-U. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 668-71(Dec. 1965). (In German).

A general formalism is given for the evaluation of the neutron density depending on position, velocity of neutrons and time. The selected theoretical method is based on the expansion of the time-dependent density of neutrons and precursors, in which the eigenfunctions by themselves are time-dependent in a determined manner. The equation for the coefficients of the set is investigated. It can be shown that because of some properties of the set of eigenfunctions approximations for this equation can be established. These approximations among other things are appropriate for the development of a generalized form of kinetic equations. (auth)

19789 MONOKINETIC NEUTRON BEAM IN THE RANGE OF 50 TO 150 Mev. Measday, D. F. (Harvard Univ., Cambridge, Mass.). Nucl. Instrum. Methods, 40: 213-20(Mar. 1966).

A monokinetic neutron beam was developed. The beam is produced by bombarding a liquid deuterium target with protons. By varying the proton energy the neutron energy is changed; energies from 50 to 150 Mev can be obtained. The neutron beam has an energy width of between 6 and 10 Mev. The main contribution to the width is the energy loss of the protons in the deuterium target. At full energy the neutron intensity is 4×10^4/sec. The beam greatly simplifies neutron-proton scattering experiments and also enables one to undertake nuclear spectroscopy. (auth)

19790 A FAST NEUTRON SPECTROMETRIC TECHNIQUE. Koehler, D. R.; Grissom, J. T. (Army Missile Command, Redstone Arsenal, Ala.). Nucl. Instrum. Methods, 40: 235-7(Mar. 1966).

A new fast neutron spectrometric technique is described, which incorporates the proton recoil distribution as a measure of the responsible neutron energy spectrum. The protons are present in a scintillator material and therefore the proton energy distribution is observed through a light detection system. Subsequent analysis of the light spectrum unfolds the neutron distribution in excellent agreement with the original neutron spectrum. (auth)

19791 A GENERAL FORMALISM FOR NUMERICAL EVALUATION OF THE POLARIZATION OF FAST NEUTRONS BY MEANS OF FINITE-GEOMETRY MEASUREMENTS OF THE LEFT-RIGHT RATIO. Aspelund, O. (AB Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods, 40: 291-304(Mar. 1966). (FFN-5).

A formalism for numerical evaluation of the polarization of fast-neutrons from finite-geometry measurements of the left-right ratio is presented. The procedure outlined is general and may be applied to any polarization experiment where a transverse magnetic field in conjunction with two detectors is used. (auth)

19792 THERMAL NEUTRON SCATTERING. Egelstaff, P. A. (ed.). London, Academic Press, 1965. 540p. 115s.

Separate abstracts were prepared for the ten chapters of the book. (D.C.W.)

For abstracts of individual chapters see: 19793–19801 and 20170.

19793 INTRODUCTORY THEORY. Lomer, W. M.; Low, G. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 1-52 of Thermal Neutron Scattering, Egelstaff, P. A. (ed.). London, Academic Press, 1965.

The various types of neutron scattering processes that occur in solids and in liquids are outlined, and formulas are given for the relevant cross sections in each case. The retarded-wave representation of the scattering from individual atoms is used in presenting the theory. 50 references. (G.O.Y.)

19794 MECHANICAL AND TIME-OF-FLIGHT TECHNIQUES. Brugger, Robert M. (Phillips Petroleum Co., Idaho Falls, Idaho). pp 53-96 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

A survey of mechanical and time-of-flight techniques for measurements of inelastic scattering is presented. 80 references. (D.C.W.)

19795 CRYSTAL DIFFRACTION TECHNIQUES. Iyengar, P. K. (Atomic Energy Establishment, Trombay, India). pp 97-140 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

A survey on the use of crystal diffraction in the measurement of energy changes in inelastic scattering experiments is presented. Both equipment and theory are considered. 84 references. (D.C.W.)

19796 NEUTRON SOURCES AND DETECTORS. Cocking, S. J.; Webb, F. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 141-92 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

A survey of neutron sources and detectors is presented. 67 references. (G.O.Y.)

19797 MAGNETIC INELASTIC SCATTERING OF NEUTRONS. Jacrot, B. (Centre d'Etudes Nucleaires, Saclay, France); Riste, T. pp 251-90 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

Magnetic inelastic scattering of neutrons is discussed in terms of its applications for determining magnetic moments, susceptibilities, and spins. 81 references. (G.O.Y.)

19798 THEORY OF NEUTRON SCATTERING BY LIQUIDS. Sjoelander, Alf (Inst. of Theoretical Physics, Gothenburg, Sweden). pp 291-345 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

A general presentation of the theory underlying neutron scattering in liquids is given. A review of approximations is presented, and some explicit models are discussed. (D.C.W.)

19799 EXPERIMENTAL RESULTS ON LIQUIDS. Larsson, K. E. (Royal Inst. of Tech., Stockholm). pp 347-411 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

Some experimental results on neutron scattering by liquid argon, liquid bromine, glycerol, liquid hydrogen, liquid metals, hydrogenous liquids, liquid sodium, and water are reviewed. 64 references. (D.C.W.)

19800 THE THEORY OF NEUTRON SCATTERING BY MOLECULES. Janik, J. A., Kowalska, A. (Jagiellonian Univ., Krakow). pp 413-51 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

The most important theories of the scattering of neutrons by molecules are described. (G.O.Y.)

19801 NEUTRON SCATTERING EXPERIMENTS ON MOLECULES. Janik, J. A.; Kowalska, A. (Jagiellonian Univ., Krakow). pp 453-96 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

The results of some experiments on neutron scattering by molecular systems are reviewed. Measurements of cross sections for gases, liquids, and solids containing hydrogen are emphasized. 94 references. (D.C.W.)

Nuclear Properties and Reactions

Refer also to abstracts 18763, 18825, 18838, 19459, 19500, 19591, 20146, 20218, 20331, 20334, and 20338.

19802 (AD–630042) THRESHOLD EFFECTS IN NUCLEAR REACTIONS. Final Report, November 1, 1962–January 31, 1966. Meyerhof, Walter E. (Stanford Univ., Calif. Dept. of Physics). 9p. (AROD–3269:27). CFSTI $1.00 cy, $0.50 mn.

Brief discussions of research during this period in the following areas are presented: threshold effects in nuclear reactions, nuclear capture reactions, polarization effects in nuclear reactions, role of isotopic spin in nuclear interactions, and properties of excited states in light nuclei. (M.O.W.)

19803 (AED–C–12–13(Pt.1)) NUCLEAR SCIENCE LITERATURE OF THE EASTERN COUNTRIES. Series C. Bibliographies. Ensslen, Benno (comp.) (Kernforschungsanlage, Juelich (West Germany)). Jan. 1966. 158p. Dep. mn.

References (651) are given to journals and reports published from 1960 through 1965. The subjects covered include: high-energy physics; nuclear structure; and nuclear reactions including general properties and theories, nuclear models, coulomb excitation, and photonuclear processes. (P.C.H.)

19804 (AED–C–12–13(Pt.2)) NUCLEAR SCIENCE LITERATURE OF THE EASTERN COUNTRIES. Series C. Bibliographies. Ensslen, Benno (comp.) (Kernforschungsanlage, Juelich (West Germany)). Feb. 1966. 184p. Dep. mn.

References (756) are given to reports and journals published from 1960 through 1965. Subjects include: nuclear reactions; electromagnetic properties of pions and nucleons; strong interactions of pions and nucleons; and weak interactions. (P.C.H.)

19805 (ANL–7110, pp 1–28) FISSION PROPERTIES AND CROSS SECTION DATA. (Argonne National Lab., Ill.).

The scattering of fast neutrons from a number of elements was investigated; an attempt was made to obtain a theoretical description of the experimental results. The fast neutron total cross sections of Al, Fe, ^{206}Pb, ^{208}Pb, and Na were determined, and the total cross sections of Al, Co, Fe, and Mg were measured in the energy range from 4 to 12 Mev. The neutron total cross sections of Re, W, U, and ^{235}U at high energies were also studied. Measurements were also made of the neutron absorption cross sections of ^{10}B and ^{7}Li, and gamma production in neutron inelastic scattering by ^{93}Nb was investigated. The fast neutron fission of ^{235}U was studied, and the half lives of ^{241}Am, ^{242}Cm, and ^{244}Cm were measured. An investigation of (d,n) reactions with ^{27}Al, ^{9}Be, ^{54}Fe, ^{24}Mg, ^{58}Ni, and ^{28}Si was also carried out. (D.C.W.)

19806 (ANL–7130, pp 313–25) THE MOMENTUM DEPENDENCE OF THE HELICITY OF BETA PARTICLES. Greenberg, J. S.; Lazarus, D. M. (Yale Univ., New Haven, Conn.).

The results of a Mott scattering analysis of the momentum dependence of the helicity in the allowed Gamow–Teller transition in ^{60}Co are presented. A velocity range of 0.7 to 0.4C was covered. The experimental technique was discussed in relation to V–A theory. (M.O.W.)

19807 (ANL–7130, pp 333–6) INDICATION OF PARITY MIXING IN AN ELECTROMAGNETIC TRANSITION. Scharff-Goldhaber, G.; McKeown, M. (Brookhaven National Lab., Upton, N. Y.).

An investigation of the parity-forbidden M1 component of the 57-kev transition in ^{180}Hf was made. A brief outline of the results is presented. (M.O.W.)

19808 (ANL–7130, pp 409–20) RECENT WORK ON THE RENORMALIZATION OF THE AXIAL-VECTOR COUPLING CONSTANTS. Weisberger, William I. (Stanford Linear Accelerator Center, Stanford Univ., Calif.).

The calculations which seem to give a successful explanation of the ratio of axial-vector to vector coupling constants measured in neutron β-decay are discussed. The assumptions used in the derivation are: (1) The vector and axial-vector currents measured in the weak interactions obey the equal-time commutation rules of SU(3) × SU(3) as proposed by Gell-Mann; and (2) The axial-vector current is partially conserved, which is a basis for deriving such results as the Goldberger-Treiman relation. (M.O.W.)

19809 (CEA-R–2900) ETUDE DE CORPS RADIOACTIFS A VIE TRES BREVE PRODUITS PAR NEUTRONS RAPIDES. (Study of Radioactive Nuclides of Very Short Half Life Produced by Fast Neutrons). Monnand, Edouard (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec. 1965. 54p. Dep. mn.

The activation of samples of Al, Bi, C, Tn, Pb, Mg, Tl, and Y_2O_3 by 14.3-Mev neutrons was investigated. The production and decay of ^{12}B and isomeric ^{208}Bi, ^{114}In, ^{205}Pb, ^{206}Pb, ^{207}Pb, ^{24}Na, ^{202}Tl, ^{204}Tl, and ^{88}Y were studied in detail. (D.C.W.)

19810 (EUR–119.e(Vol.2)) COMPILATION OF CROSS SECTIONS FOR SOME NEUTRON INDUCED THRESHOLD REACTIONS. Liskien, H.; Paulsen, A. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). May 1965. 32p. EURATOM.

Cross sections are presented for neutron induced reactions in the energy range 0 to 10 or 10 to 20 Mev. The reactions are generally (n,α), (n,2n), or (n,p). Nuclei considered are: ^{23}Na, ^{24}Mg, ^{27}Al, ^{28}Si, ^{31}P, ^{32}S, ^{46}Ti, ^{47}Ti, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{59}Co, ^{60}Ni, ^{63}Cu, ^{65}Cu, and ^{64}Zn. (M.O.W.)

19811 (EUR–2465.i) RICERCHE SULLA FISICA DEI NUCLEI. (Research on Nuclear Physics). (Comitato Nazionale per l'Energia Nucleare, Milan (Italy)). Mar. 1966. 90p. Dep. mn.

A general account is given of the work carried out from 1961 to 1963 by Euratom and the CNEN for the study of low-energy nuclear phenomena and the interaction of ionizing radiations and photons with matter. This concise work contains details of the organization and administration of the contract, and an indication of the general lines along which the scientific program was carried out, with particular reference to the most important results obtained. Finally, it includes the more detailed reports describing the research carried out by the individual teams, followed by a general list of references and some appendices giving details of a technical and organizational nature. (M.O.W.)

19812 (GA–6919) NEUTRON CAPTURE CROSS SECTION MEASUREMENTS AND RESONANCE PARAMETERS. Haddad, E.; Froehner, F. H.; Lopez, W. M.; Friesenhahn, S. J. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Jan. 27, 1966. Contract AT(04-3)-167. 29p. (CONF-660204–6). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Nuclear Society Meeting, San Diego, Calif.

A short review is presented on neutron capture cross section measurements and their interpretation. General experimental features of the capture technique are explained, the main detector types are discussed, and the various methods used for flux calibrations are given. Special attention is given to specific problems encountered in capture work, such as multiple scattering, gamma ray attenuation, and detector efficiency. Resonance parameter determination by shape and area analysis of capture resonance data is described. The accuracy of the resonance parameters obtainable from capture data alone and from combinations of capture, transmission, scattering, and self-indication data is discussed. (auth)

19813 (IKF–14) ENTWICKLUNG EINES HALBLEITERZAEHLER-TELESKOPS UND SEINE ANWENDUNG ZUR UNTERSUCHUNG DER REAKTION $^{28}Si(n,p)^{28}Al$. (Development of a Solid-State Detector Telescope and Its Application for Studying the Reaction $^{28}Si(n,p)^{28}Al$). Mausberg, W. (Institut fuer Kernphysik, Universitaet Frankfurt (West Germany)). Dec. 1965. 88p. Dep. mn.

A telescope was developed consisting of four solid state detectors, the first of them serving as target for the reaction $^{28}Si(n,p)^{28}Al$. Angular distributions of the proton group $p_{0,1}$ emerging from the transition to the ground state doublet of ^{28}Al were measured at neutron energies of 9.1, 14.1, and 21 Mev, the neutrons having an energy spread of about 200 kev. Absolute values of the cross sections are given. The distribution at 9.1 Mev is symmetric to 90°, but cannot be described by a Hauser-Feshbach calculation. The distributions at 14.1 and 21 Mev are asymmetric; they are fitted well by DWBA calculations of Agodi and Schiffrer if one assumes for 14.1 Mev an isotropic compound contribution of 60%. (auth)

19814 (IKF-15) UNTERSUCHUNG VON STATISTISCHEN FLUKTUATIONEN BEI DEN REAKTIONEN $^{27}Al(p,\gamma)^{28}Si$, $^{27}Al(p,p'\gamma)^{27}Al$ UND $^{27}Al(p,\alpha\gamma)^{24}Mg$. (Cross Section Fluctuations in the Reaction $^{27}Al(p,\gamma)^{28}Si$, $^{27}Al(p,p'\gamma)^{27}Al$ and $^{27}Al(p,\alpha\gamma)^{24}Mg$). Rauch, F. (Institut fuer Kernphysik, Universitaet Frankfurt (West Germany)). Dec. 1965. 58p. Dep. mn.

The reaction $^{27}Al(p,\gamma)^{28}Si$ was studied in the energy range $E_p = 4.0$ to 6.7 Mev. Excitation functions at 90° were measured for the transitions to the ground state and the first excited state of ^{28}Si in 12-kev steps. Angular distributions were taken for $4.0 < E_p < 4.3$ and $5.5 < E_p < 5.8$ Mev. Besides, excitation functions were measured for 4 of the gamma transitions in the reactions $^{27}Al(p,p'\gamma)^{27}Al$ and $^{27}Al(p,\alpha\gamma)^{24}Mg$ for $4.0 < E_p < 6.0$ Mev in steps of 12 and 8 kev. All excitation functions show strong fluctuations. A correlation analysis yields values for the level width in the compound nucleus ^{28}Si. Calculations give a strong dependence of the level width on spin, parity, and isospin. The analysis of the angular distributions of the γ-rays from $^{27}Al(p,\gamma)^{28}Si$ shows the radiation to be essentially of E1-type. (auth)

19815 (INP-440/PL) OPTICAL MODEL AMBIGUITIES FOR THE α-^{59}Co INTERACTION. Budzanowski, A.; Dudek, A.; Grotowski, K.; Kuzminski, J.; Niewodniczanski, H.; Strzalkowski, A.; Szmider, J.; Wolski, R. (Institute of Nuclear Physics, Krakow (Poland)). Jan. 1966. 11p. Dep.

The angular distribution for the elastic scattering of 24.7-Mev alpha particles by ^{59}Co was measured, together with the total cross section for alpha reactions with ^{59}Co. The data were analyzed using a simple two-body optical potential for the interaction between the incident alpha particle and the nucleus. (D.C.W.)

19816 (INP–441/PL) NIESPREZYSTE ROZPRASZANIE CZASTEK ALFA NA JADRACH ATOMOWYCH. (Inelastic Scattering of Alpha Particles on Atomic Nuclei). Budzanowski, Andrzej (Institute of Nuclear Physics, Krakow (Poland)). 1965. 139p. Dep.

Problems concerning inelastic scattering of alpha particles on 1d2s shell nuclei are discussed. The experimental angular distributions of the differential cross sections for the inelastic scattering of 25-Mev alpha particles are compared with the predictions of a simple diffraction theory and with a more advanced distorted wave Born approximation. From these comparisons the values of spin, parity and the deformation parameter of some excited levels of ^{40}Ca, ^{39}K, ^{32}S, ^{31}P nuclides were obtained. The manner of comparing the deformation parameters obtained by the above-mentioned methods with the electromagnetic values of these parameters is shown. (auth)

19817 (INR–661/IA/PL) GAMMA RAYS FROM INELASTIC SCATTERING OF 14.1 Mev NEUTRONS ON ^{12}C AND ^{16}O. Kozlowski, T.; Kusch, W.; Wojtkowska, J. (Institute of Nuclear Research, Warsaw (Poland)). Sept. 1965. 10p. Dep.

The gamma spectra from neutron inelastic scattering by ^{12}C and ^{16}O at 14.1 Mev were measured and the angular distributions of the 4.43- and 6.14-Mev gamma rays from ^{12}C and ^{16}O, respectively, were determined. (D.C.W.)

19818 (INSJ-95) NUMERICAL CROSS SECTIONS OF THE REACTION $^{15}N(p,\alpha)^{12}C$ BETWEEN 6.70 AND 15.16 Mev OF PROTON ENERGIES. Nonaka, I.; Mikumo, T.; Matsuda, K.; Koike, M.; Nagahara, Y.; Kikuchi, K.; Suzuki, A.; Maki, T. (Institute for Nuclear Study, Tokyo Univ. (Japan)). Jan. 25, 1966. 38p. Dep. mn.

Numerical values of the differential cross sections and of the integrated cross sections of the reaction $^{15}N(p,\alpha)^{12}C$ for the ground state α_0-group and the first excited state (4.43 Mev) α_1-group are presented. The incident proton energies ranged from 6.70 to 15.16 Mev. (M.O.W.)

19819 (IS-T-45) PHOTONUCLEAR YIELDS AND CROSS SECTIONS FOR THE $^{16}O(\gamma,\alpha n)^{11}C$ REACTION [Thesis]. Sanderson, Gary Kenneth (Ames Lab., Iowa State Univ. of Science and Tech.). Aug. 1965. Contract W-7405-eng-82. 47p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Bremsstrahlung yield functions for the photoproduction of ^{11}C from ^{16}O were measured from threshold to 65 Mev. The 20 minute radioactive decay of ^{11}C was detected using 0.511 Mev annihilation photons in a 3 × 5″ NaI scintillation detector. Decay curves were obtained on 1 Mev intervals from 25 to 65 Mev. These decay curves were resolved into four components corresponding to half lives of ^{15}O, ^{13}N, and ^{11}C and a time independent background using a least square fitting procedure. Energetic considerations are sufficient to prove that the primary reaction studied is $^{16}O(\gamma,\alpha n)^{11}C$. The yield functions were analyzed using the least structure technique for the cross section. The cross section exhibits a broad maximum of 0.22 mb near 40 Mev with a long shoulder extending to 65 Mev. No fine structure is evident. The cross section integrated to 65 Mev is 4.91 ± 0.85 Mev-mb. (auth)

19820 (IS-T-78) THE $^{141}Pr(\gamma,n)^{140}Pr$ CROSS SECTION IN THE GIANT RESONANCE REGION [Thesis]. Johnson, Ronald Gordon (Ames Lab., Iowa State Univ. of Science and Tech.). Feb. 1966. Contract W-7405-eng-82. 60p. Dept. mn. CFSTI $3.00 cy, $0.75 mn.

The cross section for the $^{141}Pr(\gamma,n)^{140}Pr$ reaction was studied in 0.125-Mev steps over the giant resonance region, 9.125 to 24.000 Mev. Radioactivity yield curves were analyzed by Least Structure Analysis. Eleven distinct resonances were resolved in the giant resonance region. The integrated cross section over this region was 1.79 ± 0.1 Mev-barns. (auth)

19821 (JINR-E-2561) STRUCTURE OF THE GROUND AND EXCITED STATES OF ODD-MASS DEFORMED NUCLEI IN THE REGION $153 \leq A \leq 187$. Solov'ev, V. G.; Vogel, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 36p. Dep. mn.

The interactions of quasiparticles with quadrupole and octupole phonons in deformed odd-mass nuclei are considered in the framework of the method of approximate second quantization. It is shown that the interaction of quasiparticles with phonons leads to the appearance of admixtures to the one-quasiparticle states and improves the description of these states as compared to the independent quasiparticle model. It is also shown that this interaction leads to the formation of the collective nonrotational states and of the complex structure states in odd-mass nuclei. (auth)

19822 (JINR-P–2301) O POROGOVYKH SOSTOYANIYAKH I PRIVEDENNYKH SHIRINAKH NUKLONNYKH ASSOTSIATSII V LEGKIKH YADRAKH. (On the Threshold States and Ordered Width of Nucleon Associations in Light Nuclei). Zhusupov, M. A.; Potter, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 14p. Dep. mn.

Reduced widths for a compound nucleus were calculated for ^{8}Be, ^{9}Be, ^{10}Be, ^{10}B, and ^{11}B at excitation energies up to 25 Mev. The theoretical cluster reduced widths $(2J+1)\Sigma\theta_i^2$ were compared with the experimental σ_{tot} values for the fol-

lowing typical reactions: $^{6}Li(^{6}Li,\alpha)^{8}Be$, $^{7}Li(^{7}Li,t)^{11}B$, $^{10}B(^{6}Li,d)^{14}N$, and $^{12}C(^{6}Li,\alpha)^{14}N$. The values agreed with each other within an order of magnitude. Thus, in the $^{6}Li(^{6}Li,\alpha)^{8}Be$ reaction, the 21-Mev excited state of ^{8}Be is formed with a probability factor of 22 greater than the ground state of ^{8}Be. The calculated value was found to be a factor of 12 to 13. Threshold effects can be observed in the systematic differences between the experimental and calculated values of the reduced widths near the corresponding thresholds. (TTT)

19823 (JINR-P-2431) K RASSEYANIYU CHASTITS VYSOKOI ENERGII NA YADRAKH. (On High Energy Particle Scattering on Nuclei). Kalinkin, B. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep. mn.

Longo and Moyer carried out an analysis of experimental scattering data with the use of an optical model. This analysis was based on a numerical solution of the radial part of the Klein-Gordon equation having a complex potential. The scattering of mesons (π^{+}) on ^{12}C (E_{π} = 3Bev) was investigated in order to determine the accuracy of the quasiclassical approximation. With the use of an optical potential similar to that of Longo and Moyer, it was calculated that the absorption cross section was 215 mb and that the elastic scattering cross section was 65 mb. These values by the quasiclassical method agreed to within 1 to 2% with the more accurate values of Longo and Moyer. The results of the elastic scattering analysis by the optical model can be used to estimate the inelastic scattering cross section with excitation of collective nuclear states. The cross section for exciting the 0± state in the ^{12}C nucleus (E^{*} = 7.85 Mev) was calculated to be 0.01 mb as a lower limit during scattering of 300 Mev protons. These examples illustrate that it is relatively simple to calculate the cross section of a number of inelastic processes with the use of the quasiclassical approximation. (TTT)

19824 (JINR-P-2540) VEROYATNOSTI E2- I E3-PEREKHODOV V NECHETNYKH DEFORMIROVANNYKH YADRAKH. (E2- and E3-Transition Probabilities in Odd Deformed Nuclei). Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1966. 12p. Dep. mn.

The E2- and E3-transition probabilities in odd deformed nuclei were calculated within the Nilsson model taking into account pairing correlations. Different superfluid wave functions were used. In order to fit the experimental data the effective E2- and E3-charges are introduced. It is shown that one can obtain agreement between theory and experiment using the reasonable values of effective charges and only the modified superfluid wave functions such as blocked ones, or projected onto space of fixed numbers of particles. (auth)

19825 (LAL-1153) DISPERSION CORRECTIONS TO ELECTRON SCATTERING IN ^{12}C AND ^{16}O. Bottino, A. (Laboratoire de l'Accelerateur Lineaire, Univ. de Paris, Orsay (France)); Ciocchetti, G.; Molinari, A. (Turin Univ. (Italy). Istituto di Fisica). Jan. 1966. 32p. Dep. mn.

Calculations of the dispersive corrections to elastic (^{16}O and ^{12}C) and inelastic (^{12}C) electron scattering are done in second Born approximation taking as intermediate nuclear levels the most excitable by means of electron scattering. Dispersive effects of the order of 1/Z are found at the diffraction minima of the form factors and for high energy and large angles. Wave distortions in the inelastic scattering are also briefly discussed. (auth)

19826 (MIT-2098-229) STUDY OF THE LOW-LYING ISOBARIC ANALOG STATES OF ^{89}Sr. Cosman, E. R.; Kerman, A. K.; Enge, H. A.; Sperduto, A. (Massachusetts Inst. of Tech., Cambridge). Mar. 28, 1966. Contract AT(30-1)-2098. 10p. (CONF-660306-3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference on Isobaric Spin, Tallahassee.

The analog states of the low-lying levels in ^{89}Sr were studied by the (p,p) and (p,p') reactions on ^{88}Sr. The information from conventional Breit-Wigner fits to the elastic data is compared with the results of a DWBA analysis of the $^{88}Sr(d,p)^{89}Sr$ reaction. In addition, an analysis of the $^{88}Sr(p,p)$ data is discussed, and preliminary results are given. This involves a solution of the two-coupled channel equations that describe the analog-state excitations. (auth)

19827 (N-65-21644) EFFECTS OF SHIELDING ON THE COULOMB T MATRIX. Ford, William F. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1965. 30p. (NASA-TN-D-2781). CFSTI $2.00 cy, $0.50 mn.

The Coulomb T matrix is defined as the limiting value of the T matrix for a screened Coulomb potential when the screening is slowly turned off. Study of this limiting process is facilitated by an expansion in spherical harmonics, and the l = 0 term is treated in detail. The amplitude of the T matrix changes rapidly as a function of energy in the vicinity of certain critical points. The precise value of the T matrix in these regions requires that screening be taken into account, and the appropriate formulas are derived. An expression for the T matrix previously derived by Hostler is shown to be correct except in the critical regions. (STAR)

19828 (N-65-22126) BETA DECAY OF ^{86}Rb. Thompson, Richard H.; Casper, Karl J. (Western Reserve Univ., Cleveland, Ohio). [1963]. 18p. (NASA-CR-62339). CFSTI $1.00 cy, $0.50 mn.

The beta decay of ^{86}Rb was investigated using lithium-drifted surface-barrier silicon detectors. Corrections to the spectrum were made using the measured response function of the detectors. The inner branch has an allowed spectral shape and an endpoint energy of 677 ± 5 kev, and the outer branch has a first-forbidden unique spectral shape and an endpoint energy of 1753 ± 4.5 kev. (STAR)

19829 (NIJS-R-455) THE SPECTRA OF γ-RAYS FROM THE RADIATIVE CAPTURE OF 14 Mev NEUTRONS. Cvelbar, F.; Hudoklin, A.; Mihailovic, M. V.; Najzer, M.; Ramsak, V. (Nuklearni Institut "Jozef Stefan," Ljubljana (Yugoslavia)). June 1965. 8p. (CONF-650706-25). Dep. mn.

The gamma spectra from radiative capture of 14-Mev neutrons were measured by a telescope pair spectrometer for ^{51}V, ^{52}Cr, ^{55}Mn, ^{56}Fe, and ^{59}Co. A discussion of the results is presented. (M.O.W.)

19830 (NP-15055) DELENIE ^{238}U PRI KVADRUPOL'-NOM POGLOSHCHENII GAMMA-KVANTOV. (Fission of ^{238}U During Quadrupole Absorption of Gamma Quanta). Soldatov, A. S.; Smirenkin, G. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut); Kapitsa, S. P.; Tsipenyuk, M. Yu. (Akademiya Nauk SSSR, Moscow. Institut Fizicheskikh Problem). 1965. 7p. Dep. mn.

The partial fission cross sections by dipole and quadrupole quanta can be readily distinguished from the form of the angular, fission product distribution. In the case of an even-even nucleus the possible spin states are 1^{-} for dipole absorption and 2^{+} for quadrupole absorption. The angular fission product distribution $\sigma_{1^-}(\theta) \sim \sin^2\theta$, and $\sigma_{2^+}(\theta) \sim 2\theta$. A ^{238}U layer was irradiated with 6.1, 6.9, and 7.1 Mev gamma quanta from the $^{19}F(p,\alpha\gamma)^{16}O$ reaction, which were obtained by irradiating a CaF_2 crystal with 1.45 Mev protons. The angular fission product distribution was obtained by counting the tracks in a photoplate surrounding the ^{238}U source. A least squares fit of the data gave the following angular distribution: $W(\theta) = 0.22 \pm 0.02 + (0.78 \pm 0.03)\sin^2\theta + (0.04 \pm 0.04)\sin^2 2\theta$. These data showed that the quadrupole contribution to the total fission cross-section was small in contrast to the data of Forkman and Johansson which showed a significant quadrupole contribution. Measurements of angular, fission product distributions were also carried out with bremsstrahlung at E_B = 5.2, 5.4, 5.65, 5.9, 6.4, 6.9, and 9.25 Mev. The results indicated that fission by quadrupole absorption became appreciable at

excitation energies below the threshold energy. The quadrupole cross section was 45% of the total fission cross section at E_B = 5.2 Mev. (TTT)

19831 (NP–15912) COINCIDENCE MEASUREMENTS ON NUCLIDES DECAYING BY ELECTRON CAPTURE. Steyn, J.; De Jesus, A. S. M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Physical Research Lab.). 1966. 20p. (FIS–15). Dep. mn.

The measurement of disintegration rates and branching ratios of the electron-capturing nuclides ^{22}Na, ^{65}Zn, and ^{74}As by coincidence-counting methods is described. The following branching ratios were determined: ^{22}Na—electron-capture to positron emission, 0.103 ± 0.018; ^{65}Zn—ground state electron-capture to positron emission, 29.6 ± 0.5, intensity of the positron branch, 0.0164 ± 0.0003, and the intensity of electron-capture to the excited state, 0.4980 ± 0.0018. (auth)

19832 (ORNL-P–1966) RECOILLESS GAMMA-RAY EMISSION FOLLOWING COULOMB EXCITATION. Czjzek, G. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 30p. (CONF-651135–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Southeastern Section, Charlottesville, Va.

The Mössbauer effect is briefly reviewed. The method of Coulomb excitation is discussed. This method was used to measure the recoilless γ ray emission from ^{61}Ni and ^{73}Ge when bombarded by 25-Mev ^{16}O ions.

19833 (RT/FI–(65)48) SHAPE ANALYSIS OF TIME-OF-FLIGHT NEUTRON TRANSMISSION SPECTRA. Stefanon, M.; Giacobbe, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 54p. Dep. mn.

The problem of the shape analysis of low energy neutron transmission spectra in time-of-flight experiments is considered. A numerical method is described, in which the experimental transmission is fitted by B. W. formulas with interference term between resonant and potential scattering, taking also into account both Doppler and resolution broadenings. No analytical approximation of the resolution function is made, in order to allow the analysis also in the case of very low resolution. A program for the IBM 7090 computer is given. (auth)

19834 (SGAE-CH–24/1965) BERECHNUNG DER AKTIVITAET VON ^{198}Au BEI DER BESTRAHLUNG MIT THERMISCHEN NEUTRONEN. (Calculation of the Activity of ^{198}Au by the Irradiation With Thermal Neutrons). Sorantin, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Chemie). [1965]. 25p. Dep. mn.

The number of radioactive nuclei formed in the irradiation of gold with thermal neutrons was calculated by various formulas. The resulting activity for a period of 30 days was represented graphically for fluxes from 10^{10} to 10^{15} n cm^{-2} sec^{-1}. For short irradiations (up to 50 hrs), some diagrams for the isotope production were prepared. It was shown that the conventional irradiation formulas for the calculation of the radioisotopes produced must be used only for neutron fluxes up to 10^{13} n cm^{-2} sec^{-1} because of the large capture cross section of ^{198}Au, and must then be replaced by an expanded formula. In thermal neutron fluxes of the order of magnitude of 10^{15} n cm^{-2} sec^{-1}, the decrease of ^{198}Au is so large that the activity of ^{198}Au does not approach saturation but decreases with increasing radiation time. As a result, gold foils can be used as irradiation monitors only in low fluxes; and in the production of ^{198}Au, high neutron fluxes are to be avoided. (tr-auth)

19835 (SGAE-PH–35/1965) DIE BESTIMMUNG DES EINFANGQUERSCHNITTES VON ^{156}Gd FUR REAKTOR-NEUTRONEN. (The Determination of Capture Cross Sections of ^{156}Gd for Reactor Neutrons). Lugmair, G.; Viehboeck, F. P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1965. 8p.

The capture cross section of ^{156}Gd for reactor neutrons was measured by mass-spectrometric observation of the abundances of isotopes before and after irradiation. (D.C.W.)

19836 (SGAE-PH–36/1965) UNTERSUCHUNG DER PARITAETSMISCHUNG IN ANGEREGTEN KERNZUSTAENDEN DURCH MESSUNG DER BETA-GAMMA WINKELKORRELATION. (Study of the Parity Mixture in Excited Nuclear States by Measurement of the Beta-Gamma Angular Correlation). Dydak, F.; Woda, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). 1965. 10p.

If an excited nuclear state contains a small admixture of inverse parity, an interference between the 2 transition heights of the same multipolarity, for instance E2 + M2, occurs in the γ transition. This can be observed in a β-γ angular correlation experiment as the forward-backward asymmetry (the expected deviation from the spherical symmetry amounts to approximately 10^{-3} in the nuclei ^{41}Ar and ^{203}Hg) with respect to the β particles. Measurements were made with two β and two γ detectors at 0 and 180°. The simultaneous measurement of all coincident counting rates was carried out with a 100-MHz time-amplitude converter. (tr-auth)

19837 (UCRL-14750-T) ISOBARIC SPIN CONSERVATION AND β-DECAY. Bloom, Stewart D. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 11, 1966. Contract W-7408-eng-48. 13p. (CONF-660306-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Physical Society, Conference on Isobaric Spin, Tallahassee.

Beta decay is discussed from the standpoint of V-A theory. Values for $|< H_c >|$, the charge-dependent matrix element, are discussed. Experimental data are given in conjunction with the theoretical aspects discussed. (M.O.W.)

19838 (UCRL–14760-T) THE CHARGE EXCHANGE REACTION. Anderson, J. D. (Lawrence Radiation Lab., Univ. of California, Livermore). Mar. 11, 1966. Contract W-7408-eng-48. 35p. (CONF-660306–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Conference on Isobaric Spin, Tallahassee.

An investigation of the (p,n) cross sections for the titanium isotopes A = 46–50 was made in order to check the charge independent formulation of the optical model which was independent of any optical parameters, i.e., the cross section is proportional to the neutron excess. An investigation is presented of the ^{25}Mg and ^{26}Mg (p,n) reactions which Satchler had suggested would shed some light on the mechanism involved in the (p,n) transitions to excited analog states. Also, the (p,n) cross sections on ^{17}O and ^{18}O were investigated for the purpose of deducing features of the two body force from a microscopic description of the (p,n) reaction. The results and conclusions from these experiments are presented. (M.O.W.)

19839 (UCRL–16478) MULTIDIMENSIONAL CORRELATION LATTICES AS AN AID TO THREE-DIMENSIONAL PATTERN RECONSTRUCTION. Penny, Samuel J.; Burkhard, James H. (Lawrence Radiation Lab., Univ. of California, Berkeley). Jan. 26, 1966. Contract W-7405-eng-48. 23p. (CONF-660407–2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Spring Joint Computer Conference, Boston.

A technique was developed to perform an efficient and exhaustive search for solutions of certain types of combinatorial problems. The basic tool of the technique is the "correlation lattice" for which the properties and algorithms for manipulation are presented. The technique is described as applied to the spatial reconstruction of a nuclear-particle interaction from three stereo photographs. In this example the particle-track images in each of the three stereo views must first be unambiguously correlated and the spurious images discarded. Then the spatial trajectories of the particles may be computed. Though illustrated for the nuclear-particle application, the technique is also applied in other fields. (auth)

19840 (UCRL-16723) USE OF THE PDP-5'S IN NUCLEAR EXPERIMENTS AT LRL. Andreae, Sypko (Lawrence Radiation Lab., Univ. of California, Berkeley). Feb, 1966. Contract W-7405-eng-48. 21p. (CONF-650575-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Spring Conference of Digital Equipment Corp. Users Assn., Boston.

Some data acquisition and analysis systems are discussed in which PDP-5 computers are used. (D.C.W.)

19841 (UJV-1456/65) ON THE 3^+ LEVEL IN ^{186}Os POPULATED IN THE ^{186}Re β-DECAY. Maly, L.; Vejs, M. (Ustav Jaderneho Vyzkumu, Cesjiskivebsja Akademie Ved, Rez). [1965]. 10p. Dep. mn.

With the intermediate image spectrometer modified for β-γ coincidences the coincidences of the 400 to 1100-kev gammas with the conversion electrons of the 137-kev transition were measured. The e_L 137-γ 770-kev coincidences were observed. Consequently, in addition to the known 768-kev transition, there is the other one with the closed energy. For this transition the relative intensity ratio $T_{\gamma}^{632}/T_{\gamma}^{773} = 8 \pm 2$ was determined. The corrected decay scheme of ^{186}Re is presented. (auth)

19842 (UR-875-126, Paper 1) TWO-NUCLEON EMISSION FOLLOWING ABSORPTION OF STOPPED NEGATIVE PIONS. Nordberg, M. E. Jr.; Kinsey, K. F.; Burman, R. L. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 16p.

A beam of negative pions was brought to rest in a variety of light element targets ranging from ^{6}Li to ^{27}Al. The angular distributions of neutron-proton and neutron-neutron pairs emitted in the subsequent pion capture process were measured. The protons were detected in a scintillation counter telescope and the neutrons were detected in a plastic scintillation counter with an anti-coincidence guard counter. The threshold requirements discriminated against low-energy evaporation nucleons. The angular distributions peak strongly at 180°. These distributions and the comparison of n-n to p-n rates are discussed and compared with other similar measurements and theoretical analysis. (auth)

19843 (UR-875-126, Paper 2) THEORY OF PION ABSORPTION ON LIGHT NUCLEI. Koltun, D.; Reitan, A. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 12p.

The absorption of a pion by a nucleus, with the emission of two fast nucleons, is considered in the impulse approximation such that only the two recoiling nucleons interact with the pion. Thus, the interaction of the pion or fast nucleons with other target nucleons is neglected, but this direct process is treated in some detail. (M.O.W.)

19844 (WANL-TME-1228) CHANGES IN THE GAM-TNS PROGRAM AND CROSS SECTION LIBRARY. Gibson, Gordon; Melnick, M. M.; Gray, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug. 1965. Contract SNP-1. 72p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A revised set of GAM-TNS input instructions is included. The programs are for computing thermal neutron spectra and multithermal group cross sections. Some changes in the GAM cross section library are also presented. Changes are presented for ^{10}B, Be, ^{235}U, and ^{238}U. (M.O.W.)

19845 COHERENT NEUTRON SCATTERING AMPLITUDES OF FISSIONABLE NUCLEI, ^{233}U, ^{235}U, AND ^{239}Pu. Atoji, Masao (Argonne National Lab., Ill.). Acta Crystallogr., 20: 587-8(Apr. 10, 1966).

The formula for the coherent scattering amplitude, b, was derived as $b = R' - 227.6\,\Sigma g(\Gamma_{aj}^{0}\Gamma_{ak}^{0})^{1/2} A_{jk}$ + (similar term for the other spin) where the amplitude and energy quantities are in units of 10^{-12} cm and ev, respectively; R' is the reaction nuclear radius, g the statistical factor, and Γ^0 the reduced neutron width. A_{jk} is the element of the symmetric complex matrix A. The resonance amplitudes, b' and b" were computed with the use of the resonance and interference parameters which were deduced from the total (virtually γ capture plus fission) and fission cross section analyses. However, in spite of the proximate resonance levels, b' and b" of ^{233}U and ^{235}U were very small and practically constant. The amplitude variation and the imaginary amplitude of ^{239}Pu were also small but by no means negligible in the high-precision structure analysis. Regarding the results, several conclusions were made. (P.C.H.)

19846 NUCLEAR SPECTROSCOPIC INVESTIGATIONS WITH g-FACTOR AND LIFETIME DETERMINATIONS OF EXCITED NUCLEAR LEVELS. Jentschke, W.; Koerner, H. J.; Skorka, S. J. (Univ., Hamburg). Acta Phys. Austr., 21: 43-67(1966). (In German).

The methods for the g-factor measurement of excited nuclear levels with perturbed γ-γ angular correlations and methods for lifetime measurements with nuclear resonance fluorescence excitations are described, and some results are discussed. (tr-auth)

19847 INVESTIGATION OF THE MOESSBAUER SPECTRUM OF THE K CONVERSION LINE OF ^{57}Fe USING AN HYDRAULIC MOESSBAUER SPECTROMETER. Schabel, P.; Ujlaki, E. (Univ., Vienna). Acta Phys. Austr., 21: 154-62(1966). (In German).

A Mössbauer analyzer was developed whose function depends on the constant flowing of a viscous liquid. Its construction and the Mössbauer resonance experiments carried out on ^{57}Fe using this spectrometer are described. The investigation of the Mössbauer spectrum of the K conversion line that occurs in the resonance scattering on a stainless-steel foil with a natural isotopic mixture is described in detail. (tr-auth)

19848 SYSTEMATICS OF THE DECAY ENERGY OF α EMITTERS AND THE SHELL MODEL. Schintlmeister, Josef (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Acta Phys. Austr., 21: 168-77(1966). (In German).

In order to review quantitatively the effect of the shell structure of the nucleus on the α decay energies, the difference between the experimental decay energies and the energies calculated by the Weizsäcker equation is determined. From the systematics of these differences, assumptions on the decay energies for nuclei with Z = 80, 82, and 86 are derived. The increase of these differences in the heaviest nuclei is put in relation with their spontaneous fission. The possibility of a fission isomerism is discussed. (tr-auth)

19849 LOCATIONS OF NEUTRON SINGLE PARTICLE STATES. Cohen, Bernard L. (Univ. of Pittsburgh). Amer. J. Phys., 33: 1011-23(Dec. 1965).

The meaning and importance of single-particle (SP) states in nuclear shell theory is outlined, and the method of determining them from studies of deuteron stripping reactions is described. The results on locations of SP states are summarized and analyzed to obtain information on the shell theory potential. The depth of this potential is found to have a symmetry energy dependence somewhat weaker than that for optical model potentials for protons. The "self-binding energy," a lowering of the energy of a SP state as it fills, plays an important role; its magnitude is determined and an empirical expression for it is given. Special neutron-proton interactions must be taken into account in a few cases. The spin-orbit potential seems to be of the form $f(r)\sigma \cdot l$ where $f(r) = r^{-1}dV/dr$; a volume or a simple surface force are excluded. The explicit l-dependence of SP energies is much less than that commonly used, and indicates that the potential is much closer to an oscillator than to a square well in shape. The spacings between major shells require a velocity dependent potential corresponding to an effective mass of 1.3 times the nucleon mass. The shift of SP energies with A indicates that the well gets shallower with increasing A; the depth change is about 5.8 Mev from Ca to Pb. Locations of neutron giant resonances are estimated. (auth)

19850 DEVELOPMENT OF SOME NEW EXPERIMENTS IN NUCLEAR AND PARTICLE PHYSICS. Amer. J. Phys., 34: 9-18(Jan. 1966).

A discussion was held to consider the development of some experiments in nuclear and particle physics for use in college and university instructional laboratories. Three groups of experiments are outlined: experiments on energy loss of α particles in scintillation and surface-barrier detectors and on measurement of fission fragment energies; $\gamma-\gamma$ angular correlation measurements; and muon decay and the use of spark chambers with lower energy particles. (auth)

19851 FOUNDATIONS OF CALCULATION IN ERROR STATISTICS IN THE MEASUREMENT OF NUCLEAR RADIATION. PART I. **Weise, Lothar** (Zentralinstitut fuer Reaktorexperimente, kernforschungsanlage des Landes Nordrhein-Westfalen, Juelich, Ger.). Arch. Tech. Messen, 346: 247-52(Nov. 1964). (In German).

Statistics of nuclear decay are considered, with discussion of polynomial, binomial, Poisson, and Gaussian distribution. Statistical error in counting of impulses is outlined under the topics of the fundamental equation for error, minimalization, reduction of the null effect, and errors in minimum values. Examples of appropriate calculations are given. Calculations for predetermined ratios of measurement time or of impulse counts are illustrated. Statistical sensitivity criteria for detectors are discussed. Separation and detection limits of confidence are calculated for constant and variable background. Statistical errors in measurement with a rate meter are outlined; topics include errors in single measurements, and errors in multiple measurements, as functions of time. Problems of solution times and supports are considered, with illustrations for counters of the first and second kind, especially counters in series with support in parallel. (BBB)

19852 THE $^{16}O(\gamma,p_0)^{15}N$ CROSS SECTION BETWEEN 14 AND 16 Mev. **Stewart, R. J. J.; Cannington, P. H.; Spicer, B. M.** (Univ. of Melbourne). Austral. J. Phys., 18: 661-4(Dec. 1965).

An experimental investigation was made of the 90° differential cross section for the $^{16}O(\gamma,p_0)^{15}N$ reaction from 14 to 16 Mev, in an attempt to resolve an apparent discrepancy between the published $^{16}O(\gamma,p_0)^{15}N$ and $^{15}N(p,\gamma_0)^{16}O$ cross sections in this energy range. The feature of interest in the results presented is the absence of any peak in the region of 14.7 Mev, which strongly suggests that the earlier (γ,p) work is incorrect and that no real discrepancy exists between the (γ,p_0) and (p,γ_0) results. Good agreement in shape was also found between the cross section obtained in the present work and that derived from the (p,γ_0) cross section using the principle of detailed balance. (L.B.S.)

19853 ENERGY AND ANGULAR DISTRIBUTION OF ALPHA PARTICLES IN THE $^{40}Ar(n,\alpha)^{37}S$ REACTION AT 14.1 Mev. **Hsu, Yuin-Chi; Huang, Chia-Yi; Huang, Chao-Yang; Lin, Song-Yung** (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 3: 90-7(Oct. 1965).

The energy and angular distribution of alpha particles from the $^{40}Ar(n,\alpha)^{37}S$ reaction induced by 14.1-Mev neutrons were measured with an argon-gas filled cloud chamber. The angular distribution for the entire energy region is approximately symmetrical with 90° and concave upward. The energy distribution shows that more alpha particles are emitted than has been expected from the statistical theory. Values for the level density parameter a, the nuclear temperature T and the spin cut-off parameter σ are evaluated from these data. (auth)

19854 SHELL STRUCTURE OF TWO-DIMENSIONAL NUCLEI. **Hwang, Jenn-Lin; Liu, Clara** (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 3: 109-15 (Oct. 1965).

The shell structure of atomic nuclei has an intimate relation with a geometrical property of the space. This property is examined further for a hypothetical two-dimensional nucleus. Two schemes of level sequence calculation, Nilsson scheme and a bounded harmonic oscillator potential scheme proposed by Sen Gupta and Ghosh, are adopted to determine the magic numbers. The determined numbers coincide exactly with those predicted by the particle capacity of circular rings; they are either 2, 6, 14, 22, 32, 44 ... or 2, 6, 12, 22, 44 ..., depending on the magnitude λ of the spin-orbit interaction. The rule for the nuclear radius is not so pretty as the one for the three dimensional case. However, owing to this rule, a parameter of the potential well can be determined and the level sequence calculation becomes possible. (auth)

19855 BAND STRUCTURE OF NUCLEAR LEVELS AND PAIRING CORRELATION INTERACTIONS. **Hwang, Jenn-Lin** (National Taiwan Univ., Taipei, Taiwan). Chin. J. Phys. (Taiwan), 3: 116-19(Oct. 1965).

The modern theory of superconductivity applied to a statistical model of nuclei predicts the phase transition energy all at 2.73 Mev or so for a wide range of mass numbers. This transition energy curve is identified with one of the curves which were found by Sakai from a plot of the number of levels against the excitation energy. (auth)

19856 DISTRIBUTIONS OF THE NEUTRON RESONANCE PARAMETERS OF ^{239}Pu FROM 0 TO 200 ev. **Blons, Jacques; Derrien, Herve; Michaudon, Andre; Ribon, Pierre; De Saussure, Gerard** (CEN, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 262: 79-82(Jan. 3, 1966). (In French).

The resonance parameters of ^{239}Pu below 200 ev were obtained from fission and transmission measurements. The distributions of spacings and reduced neutron widths are in good agreement with the theoretical laws. The distribution of fission widths seems to indicate the existence of two families of resonances with each corresponding to one spin state. But the interpretation of the results is made more difficult by the interferences of the fission channels. (tr-auth)

19857 α SPECTROMETRY OF ^{230}Pa AND ^{230}U. **Bastin, Genevieve; Leang, Chin Fan; Walen, Robert J.** (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Compt. Rend., Ser. B, 262: 89-92(Jan. 3, 1966). (In French).

The α magnetic spectrum for ^{230}Pa shows a large number of new lines and confirms the branchings. In ^{230}U three new lines of collective bands were found. (tr-auth)

19858 MEASUREMENTS OF THE CIRCULARLY POLARIZED $\beta-\gamma$ CORRELATION IN THE $2^-(\beta)2^+$ $(\gamma)0^+$ TRANSITION OF ^{86}Rb. **Renard, Jean-Claude; De Saintignon, Paul; Viano, Jean-Bernard; Depommier, Pierre** (Universite et Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., Ser. B, 262: 145-7(Jan. 10, 1966). (In French).

The degree of circular polarization $P_c(\theta_{\beta\gamma})$ of the 1.07-Mev γ ray following the singly-forbidden nonunique β transition $(2^- \rightarrow 2^+)$ of ^{86}Rb was measured for different values of the angle $\theta_{\beta\gamma}$. (tr-auth)

19859 STUDY OF THE ELECTROMAGNETIC DEEXCITATION MODES OF THE LEVELS AT 1050 kev AND 1380 kev IN ^{58}Co. **Gorodetzky, Serge; Gehringer, Claude; Chevallier, Pierre; Drouin, Robert; Sutter, Gilbert** (Institut de Recherches Nucleaires, Strasbourg). Compt. Rend., Ser. B, 262: 206-9(Jan. 17, 1966). (In French).

The levels observed by Croissiaux were redetermined with precision, and the electromagnetic de-excitation modes of the two levels were studied. The variation of the ratio of slow neutrons to fast neutrons was determined and shown graphically. One level was defined at 1055 ± 15 Kev and the other at 1395 ± 15 kev. The electromagnetic de-excitation scheme proposed for the excited states is shown. (J.S.R.)

19860 β SPECTRA OF ^{86}Rb. **Andre, Stephane; Depommier, Pierre** (Universite et Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., Ser. B, 262: 214-17(Jan. 17, 1966). (In French).

The β spectrum of the transition $2^- \rightarrow 2^+$ of ^{86}Rb was measured by $\beta-\gamma$ coincidences using a spectrometer of the Siegbahn-Slätis type. Its form is close to the permitted form but is very sensitive to the value adopted for the maximum energy; it favors a predominance of the matrix

element $\int B_{ij}$. The form factor of the spectrum of the principal transition $2^- \rightarrow 0^+$ has a slight negative slope of the order of 2% per mc^2. (tr-auth)

19861 PRELIMINARY RESULTS ON THE EMISSION OF α PARTICLES DURING THE FISSION OF URANIUM BY NEUTRONS AT 14 Mev. Gillet, Alain; Doan, Thu Phong; Carles, Claude; Chastel, Raymond (Faculte des Sciences, Bordeaux). Compt. Rend., Ser. B, 262: 296-9 (Jan. 24, 1966). (In French).

The fission of natural uranium induced by 14-Mev neutrons accompanied by the emission of a light charged particle was studied, principally from the angular viewpoint, by the technique of charged nuclear emulsions. The angular distribution of these particles with respect to the incident beam presents only a slight anisotropy. (tr-auth)

19862 THE LEVELS OF ^{165}Tm FROM THE DECAY OF ^{165}Yb. Paris, Pierre (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Compt. Rend., Ser. B, 262: 304-6(Jan. 24, 1966). (In French).

An experimental study of the decay ^{165}Yb $\rightarrow$ ^{165}Tm showed the existence of 6 transitions with energies of 13.7, 32.3, 68.6, 80.1, 105.5, and 185.8 kev. An energy level scheme for ^{165}Tm was thus established. (tr-auth)

19863 PERTURBED ANGULAR CORRELATION IN A HAFNIUM OXIDE SOURCE. Marest, Gilbert; Berkes, Istvan; Bougnot, Georges; Beraud, Robert (Institut de Physique Nucleaire de Lyon, Villeurbanne, France). Compt. Rend., Ser. B, 262: 367-9(Jan. 31, 1966). (In French).

The angular correlation of the 133–482 kev cascade of the ^{181}Ta nucleus was studied in a polycrystalline source of hafnium oxide. The static electric quadrapole interaction of frequency $\omega_0 = 780 \pm 70$ MHz can be explained by the monoclinic structure of the source used. (tr-auth)

19864 ENERGY LEVELS OF ^{223}Fr. Bastin, Genevieve; Leang, Chin-Fang; Walen, Robert J. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Compt. Rend., Ser. B, 262: 370-2(Jan. 31, 1966). (In French).

The energy levels of ^{223}Fr were studied by the means of α decay of ^{227}Ac. An interpretation into rotational families was attempted. (tr-auth)

19865 NUCLEAR PHOTOACTIVATION OF NATURAL SILVER, ITS 107 AND 109 ISOTOPES, AND NATURAL CADMIUM. Cauchois, Yvette; Heno, Yvonne; Boivin, Michel (Faculte des Sciences, Paris). Compt. Rend., Ser. B, 262: 503-6(Feb. 14, 1966). (In French).

The photoactivation of natural silver, its separated 107 and 109 isotopes, and natural cadmium was studied. The excitation levels obtained were 423, 780, 945, 1250, and 1325 kev for ^{107}Ag, 410, 680, 855, 1210, and 1480 kev for ^{109}Ag, and 760, 1120, and 1300 kev for ^{111}Cd in natural Cd. The corresponding cross sections were calculated, and the partial radiative widths were discussed. The energies of the isomeric levels of ^{107m}Ag and ^{109m}Ag at approximately 88 and 94 kev were localized with respect to K-absorption discontinuities of Pb and Bi. (tr-auth)

19866 DETERMINATION OF THE SPIN OF SOME RESONANCES INDUCED IN ^{103}Rh AND ^{197}Au BY SLOW NEUTRONS. Trochon, Jean; Lottin, Andre; Ribon, Pierre (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 262: 507-10(Feb. 14, 1966). (In French).

Measurements of scattering cross sections by the time-of-flight method were made around the Saclay electron linear accelerator, used as a source of pulsed neutrons. The measurements made it possible to determine the spin of some excited levels of the compound nuclei ^{104}Rh and ^{198}Au. (tr-auth)

19867 STUDY OF THE CHARGE OF RECOIL ATOMS OF AN ACTIVE DEPOSIT OF THORIUM BY A TIME-OF-FLIGHT METHOD. Perrin, Nils; De Wieclawik, Wladyslaw (Institut de Radium, Orsay, France). Compt. Rend., Ser. B, 262: 511-14(Feb. 14, 1966). (In French).

The recoil atoms following α emission are accelerated by an electric field and their velocity was determined by a time-of-flight method. Charges from 0 to 2, corresponding to the fundamental α ray, and from 5 to 16, for the fine-structure α rays, were measured. (tr-auth)

19868 NUCLEAR PHOTOEFFECT IN ^{3}H. Boesch, R.; Lang, J.; Mueller, R.; Woelfli, W. (Lab. of Nuclear Physics, Zurich). Helv. Phys. Acta, 38: 753-82(1965). (In German).

The total cross section and the angular distribution of the reaction $^3H(\gamma,n)^2H$ were measured using four (n,γ)-spectra as gamma ray sources. These results, together with those of other experiments (e.g. electron scattering) give information about the ground state wave function of the nuclei under investigation. It is shown, that one has to describe the ground state of the three-particle nuclei with an admixture of a state whose eigenfunctions are not symmetric with respect to the space coordinates of all three nucleons (S'-state). The experimental data show a definite preference for the Gunn-Irving form of wave function over Gaussian and modified exponential forms. The size parameter for the Gunn-Irving wave function is determined and the probability of the S'-state is found to be 0.5%. (auth)

19869 A METHOD OF MEASUREMENT OF NUCLEAR RELAXATION TIMES FOR VERY WEAK SIGNALS. Cornaz, Piet (Univ. Lausanne, Switzerland). Helv. Phys. Acta 38: 813-40(1965). (In French).

In the perspective of a study of nuclear magnetic relaxation in gases and of the effects of relaxation due to walls, in an average field of about 400 gauss, the following optimum experimental conditions are established: observation of strongly saturated scattering and use of high-frequency modulation. This technique allows the ratio T_1/T_2 to be found directly. The high-frequency modulation is analyzed in detail. Since the classical methods of measuring the nuclear relaxation times are incompatible with this technique of observation, a new method is described. It uses pulses of the continuous field to reverse periodically the nuclear magnetic moment, while the radiofrequency is applied in a continuous manner. The method allows the utilization of a synchronous detector ("lock-in") with large time constant. (tr-auth)

19870 MEASUREMENT OF THE POLARIZATION OF 3.8- AND 4.6-Mev NEUTRONS ELASTICALLY SCATTERED BY DEUTERIUM. Schwarz, E. Helv. Phys. Acta, 38: 877-99(1965). (In French).

The polarization of neutrons elastically scattered on deuterium was determined by measuring the left-right asymmetry of the angular distribution. The neutron energies, 3.8 and 4.6 Mev, fall in a region where few results exist. The selection of the scattered neutrons was obtained by measuring their time-of-flight between the scatterer (C_6D_6 liquid scintillator) and two neutron detectors symmetrically located at left and right at $\vartheta_{CM} = 72°$ (plastic scintillators). The different precautions necessary to eliminate every instrumental asymmetry are described in detail. To check the overall setting of the measuring system and associated electronics, deuterium was replaced by normal hydrogen in the scatterer. The results are as follows: For 3.83 Mev neutrons and taking the polarization P_1 of the incident D–D neutrons at 50° lab to be −15%: $P_2 = (5.3 \pm 3.3)\%$. For 4.57 Mev and $P_1 = -13\%$: $P_2 = (5.4 \pm 3.8)\%$. These results are discussed and compared with the known data in adjacent angular and energy regions. (auth)

19871 CALORIMETRIC DETERMINATION OF THE HALF LIFE OF ^{124}Sb. Fleming, D. M.; Myers, I. T. (Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. Int. J. Appl. Radiat. Isotop., 17: 251-2(Apr. 1966).

An improved decay rate value for ^{124}Sb obtained by γ calorimetry is presented. A relative accuracy of ±0.02% was maintained throughout the experiment. Corrections

were made for ^{122}Sb and ^{125}Sb. The data extended over three half lives and included 163 data points. The final, corrected value was 60.20 ± 0.03 days, where the error represents a confidence level of approximately 95%. The standard deviation was 0.012 days. Previously acquired data on the ^{124}Sb half life are tabulated. (H.G.D.)

19872 ON THE MASSEY-MOHR METHOD FOR TOTAL ELASTIC CROSS SECTION. **Shin, H. (Univ. of Nevada, Reno). J. Chem. Phys., 44: 2538-9(Mar. 15, 1966).**

The importance of the higher-order terms of $\eta(l,E)$ in the calculation of elastic cross section (Q) was determined. The Massey-Mohr method breaks Q into two parts, $Q_{MM} = Q_1 + Q_2$. For the purpose of illustrating the importance of these terms, the case was considered in which s = 6. It was concluded that the MM method can give valuable information about the magnitude of Q and its velocity dependence, if the higher-order terms of $\eta(l,E)$ are included. (P.C.H.)

19873 ON THE CALCULATION OF PARTICLE-HOLE MATRIX ELEMENTS. **Husain, D. (Univ., Dacca, Pakistan). J. Natur. Sci. Math., 5: 159-62(Oct. 1965).**

A simple method is suggested to calculate the particle-hole interaction matrix elements both for Wigner forces and for zero-range saturation mixture. (auth)

19874 A STUDY OF NUCLEAR PROPERTIES WITH VELOCITY-DEPENDENT TWO-BODY INTERACTIONS. **Chowdhury, A. H.; Husain, D.; Choudhury, A. L.; Rafiqullah, A. K. (Univ., Dacca, Pakistan). J. Natur. Sci. Math., 5: 181-6(Oct. 1965).**

Attempt is made to explain saturation properties of the nuclei by introducing a velocity dependent two body potential of the form $V_0(e^{-\mu\gamma}/\mu\gamma) + (\lambda/M)p\cdot(e^{-\mu\gamma}/\mu\gamma)$. p and binding energies per particle of an infinite nucleus, single particle energies and effective mass of the nucleons in motion are calculated in the first order perturbation theory using this potential. Fair agreement with the empirical values are obtained with $\mu = 0.857 \times 10^{13}$ cm^{-1}, $V_0 = 51$ Mev and $\lambda = 0.243$. (auth)

19875 S-STATE BINDING OF THE ALPHA PARTICLE. **Rahman, H. U. (Manchester Coll. of Science and Tech., Eng.). J. Natur. Sci. Math., 5: 240-2(Oct. 1965).**

A method in which the Gauss radial function is used to obtain a modified wave function is applied to calculate the binding energy of the ^{4}He nucleus by the variational procedure. A typical short range two-body central interaction that is charge symmetric and has a Gaussian radial dependence is used in the hamiltonian. The minimum eigenvalue obtained from the single modified S-wave function is −15.6 Mev (approximately −58.5% of the experimental value). (L.B.S.)

19876 (α,d) AND (α,t) REACTIONS ON ^{9}Be, ^{19}F AND ^{27}Al AT 28.6 Mev. **Kakigi, Shigeru (Kyoto Univ.). J. Phys. Soc. Jap., 20: 1967-80(Nov. 1965).**

Momentum spectra were obtained at several angles for deuteron and triton groups from the (α,d) and the (α,t) reactions on ^{9}Be, ^{19}F, and ^{27}Al at 28.6 Mev with a broad range magnetic analyzer and nuclear emulsions. The particles were identified by the measurement of the track length of the particles in the emulsions. The (α,d) reactions were found to be similar to the (d,p) reactions in the behavior of the excitation of the residual nuclear states explained by the Nilsson model. For the single particle states, the higher l-value transition is favored in the (α,d) reaction in contrast to the (d,p) reaction. In the (α,t) reaction the differential cross sections for the ground states of ^{10}B and ^{28}Si and for the first excited state of ^{20}Ne are preferentialy large and show forward rise. (auth)

19877 THE HOLE STATE BY THE REACTIONS ^{40}Ca(p,d)^{39}Ca, ^{52}Cr(p,d)^{51}Cr, AND ^{60}Ni(p,d)^{59}Ni. **Ejiri, Hiroyasu; Saji, Yoshio; Ishizaki, Yoshihide; Koike, Masahiro; Matsuda, Kazuhisa; Nonaka, Itaru; Yagi, Kohsuke; Nakajima, Yutaka; Tanaka, Eiji (Tokyo Univ.). J. Phys. Soc. Jap., 21: 14-24(Jan. 1966).**

Deuterons from (p,d) reactions on ^{40}Ca, ^{52}Cr, and ^{60}Ni were investigated by using 55 Mev proton beam from the INS synchrocyclotron. Deuterons were analyzed by a broad range magnetic analyzer coupled with a pair of quadrupole magnets and were detected with forty fold proportional counters followed by a plastic scintillator. Predominant deuteron groups were observed corresponding to the single hole states of neutrons in ^{39}Ca, ^{51}Cr and ^{59}Ni. Angular distributions of the deuteron groups were analyzed in terms of the distorted wave Born approximation. Fairly good agreements between the calculations and the experiments were obtained for both the angular distributions and the spectroscopic factors. Brief discussions on the properties of the hole states and the binding energies are presented. (auth)

19878 CALCULATION OF THE ACTIVITY OF ^{196}Au ON IRRADIATION WITH THERMAL NEUTRONS. **Sorantin, H. (Osterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Monatsh. Chem., 96: 1754-65(1965). (In German).**

The number of ^{198}Au nuclei formed on irradiation of Au with thermal neutrons is calculated by several formulas and the resulting activity for 30 days for fluxes between 10^{10} n cm^{-2} sec^{-1} and 10^{15} n cm^{-2} sec^{-1} is described graphically. For short irradiations (up to 50 hr) special diagrams for isotope preparation are prepared. The conventional irradiation formulas for calculation of production of radionuclides may be used only up to 10^{13} n cm^{-2} sec^{-1} because of the large cross section of ^{198}Au for neutron capture. Conversion of ^{198}Au to ^{199}Au and ^{200}Au decreases yields of ^{198}Au above 5×10^{13} n cm^{-2} sec^{-1}; in fact the amount of ^{198}Au decreases with increasing time under larger fluxes. Preparation of ^{198}Au from Au foils must thus be carried out at low fluxes, and Au foils should be used as radiation monitors only with low fluxes. Charts for production of the heavier isotopes are also given. (BBB)

19879 REVISED A-CHAINS: A = 182 (Hf, Ta, W, Re, Os, Ir, and Pt). **Way, K. (comp.). Nucl. Data, 1: B1.1-36 (Feb. 1966).**

Nuclear data for isotopes of mass 182 are presented. These data include energy-level properties, spin and parity designations, also conversion-coefficient, decay, and reaction data. (J.F.P.)

19880 REVISED A-CHAINS: A = 183 (Hf, Ta, W, Re, Os, Ir, Pt, and Au). **Artna, A. (comp.). Nucl. Data, 1: B1.37-62(Feb. 1966).**

Nuclear data for isotopes of mass 183 are presented. These data include energy-level properties, spin and parity designations, also decay, mass-spectroscopic, and reaction data. (J.F.P.)

19881 REVISED A-CHAINS: A = 184 (Ta, W, Re, Os, Ir, and Pt). **Martin, M. J. (comp.). Nucl. Data, 1: B1.63-81(Feb. 1966).**

Nuclear data for isotopes of mass 184 are presented. These data include energy-level properties, spin and parity designations, also decay, mass-spectrographic, and reaction data. (J.F.P.)

19882 REVISED A-CHAINS: A = 185 (Ta, W, Re, Os, Ir, Pt, Au, and Hg). **Sen Gupta, A. K. (comp.). Nucl. Data, 1: B1.83-103(Feb. 1966).**

Nuclear data for isotopes of mass 185 are presented. These data include energy-level properties, spin and parity designations, also decay, mass-spectrographic, and reaction data. (J.F.P.)

19883 EXPERIMENTAL EXCITATION FUNCTIONS FOR (n,p), (n,t), (n,α), (n,2n), (n,np), AND (n,nα) REACTIONS. **Jessen, P.; Bormann, M.; Dreyer, F.; Neuert, H. (Univ., Hamburg). Nucl. Data, 1: 103-4(Feb. 1966).**

Fast neutron cross sections for (n,p), (n,t), (n,α), (n,2n), (n,np), and (n,nα) reactions, leading to all possible final states, are presented in graphic form. Neutron energies range up to 20 Mev. Targets include nuclei from ^{2}H to ^{238}U. The compilation covers data available in June 1965. (auth)

19884 NUCLEAR STRUCTURE AWAY FROM THE REGION OF β STABILITY. Bes, D. R. (NORDITA, Copenhagen). Nucl. Instrum. Methods, 38: 277-81(1965).

The predictions on nuclei lying away from the line corresponding to β-stability are reviewed. The influence of the forthcoming experimental data on the present description of the nuclear structure is also discussed. (auth)

19885 PROJECT FOR AN ISOTOPE SEPARATOR ON-LINE WITH THE CERN SYNCHROCYCLOTRON. Rudstam, G. (CERN, Geneva). Nucl. Instrum. Methods, 38: 282-90(1965).

Until now nuclear decay properties have been studied mainly in a narrow band around stability. The extension of these studies further away from stability requires special techniques in order to overcome the difficulties caused by the decreasing half lives of the nuclides. An experiment of this kind is being prepared at CERN as a joint project with participation from Denmark (Aarhus and Copenhagen), France (Orsay), Germany (Heidelberg), Norway (Oslo), Sweden (Gothenburg and Stockholm) and CERN (Nuclear Chemistry Group). The intention is to bombard a target held at high temperature with the external 600 Mev proton beam of the synchro-cyclotron. The reaction products, diffusing out of the target will be pumped into the ion source of an isotope separator through a chemical separation column containing traps for unwanted elements. The ions will ultimately be collected directly in front of the measuring instruments (solid state alpha-, beta- and gamma-spectrometers and an electromagnetic beta-spectrometer are foreseen). In favorable cases activities with half lives down to about one second should be measurable using this technique. By the use of a high-energy synchrocyclotron as the radiation source both neutron-deficient (spallation products) and neutron-rich nuclides (fission products) can be studied. (auth)

19886 THE DETECTION OF THE SHORT-LIVED LITHIUM ISOTOPES ^{8}Li AND ^{9}Li BY PRELIMINARY EXPERIMENTS WITH AN ON-LINE MASS SPECTROMETER. Klapisch, R.; Bernas, R. (CNRS, Orsay, France). Nucl. Instrum. Methods, 38: 291-5(1965).

A mass-spectrometer equipped with a special ion source was constructed so as to be installed in the external beam of the Orsay synchrocyclotron. The time necessary for the nuclear species produced in the target to diffuse out can be varied by changing the target thickness and temperature. Experiments conducted on carbon and boron targets at temperatures up to 1800°C show that short lived ^{8}Li and ^{9}Li can be detected satisfactorily. (auth)

19887 EXPERIENCES OF ON-LINE ISOTOPE SEPARATION OF SHORT-LIVED ISOTOPES. Borg, S.; Faegerquist, U.; Holm, G.; Kropff, F. (Research Inst. for Physics, Stockholm. Research Inst. of National Defence, Stockholm). Nucl. Instrum. Methods, 38: 296-8(1965).

Short-lived krypton and xenon isotopes were studied by fission of enriched uranyl stearate. The isotope-separated ion beam was collected on a movable tape system (isobar separator) such that the detection of a certain nucleus in the isobaric chain could be optimized. Li-drifted germanium, NaI and anthracene detectors were used. Nuclei with half lives in the region 4 min to 10 sec (^{137}Xe, ^{139}Xe, ^{140}Xe, ^{90}Kr, ^{91}Kr) were studied. Further experiments for investigation of nuclei with half lives less than 10 sec are discussed. (auth)

19888 ON-LINE SEPARATION OF SHORT-LIVED PRODUCTS FROM ^{252}Cf SPONTANEOUS FISSION. Sidenius, G.; Gammon, R. M.; Naumann, R. A.; Thomas, T. D. (Princeton Univ., N. J.). Nucl. Instrum. Methods, 38: 299-302(1965). (PPAD-2137-559).

Some problems related to on-line separation of short-lived activities were studied using a spontaneous fission source. A series of different fission product catchers were studied and the relative yield of the heavy Xe isotopes measured. A nuclear radiation detector employing three detectors and a moving collection tape is described. (auth)

19889 THE ISOTOPE SEPARATOR PROGRAM AT THE PRINCETON-PENNSYLVANIA ACCELERATOR. Naumann, R. A.; Sidenius, G. (Princeton Univ., N. J.). Nucl. Instrum. Methods, 38: 319-22(1965). (PPAD-2137-557).

The initial isotope separation program at the Princeton-Pennsylvania Accelerator is outlined. The procedures used for the mass dispersion of mercury and thallium radioisotopes produced in lead irradiated with 3 Bev protons are described. Some preliminary nuclear spectroscopic results for the 190, 192 and 194 mass chains are given. (auth)

19890 NUCLEAR SPECTROSCOPY MEASUREMENTS EMPLOYING MODULATION OF TARGET POTENTIAL. Morris, J. M.; Ophel, T. R. (Australian National Univ., Canberra). Nucl. Instrum. Methods, 40: 245-53(Mar. 1966).

Precision measurements that may be obtained by applying voltage modulation to a target bombarded with a fixed energy beam are discussed. Examples are given for studies of beam and resonance parameters, target thickness measurements, dE/dx determinations, the observation of Symon-Landau energy distributions, excitation function measurements and charge state effects of reaction products. (auth)

19891 STUDY OF THE ^{37}Cl(p,n)^{37}Ar REACTION. Iyengar, K. V. K.; Gupta, S. K.; Lal, B.; Kondaiah, E. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 76: 433-41(Feb. 1966).

The yield of 1.42 Mev gamma rays from the ^{37}Cl(p,n)^{37}Ar reaction, measured in the proton energy region 3.0-5.5 Mev shows broad peaks at E_p = 3.6 and 4.5 Mev. The $n_1-\gamma$ angular correlation measured at E_p = 4.3 Mev is isotropic. This is consistent with the assignment $J = \frac{1}{2}$ to the 1.42 Mev level of ^{37}Ar. The angular distribution of the n_0 group in the same reaction was measured at proton energies of 5.1, 5.3, and 5.5 Mev. These distributions change with proton energy and are neither isotropic nor fully symmetric around 90°. Analysis indicates the failure of the random phase approximation for this reaction at these energies. (auth)

19892 ^{63}Cu BY THE UNIFIED MODEL. Bouten, M.; Van Leuven, P. (Studiecentrum voor Kernenergie, Mol, Belg.). Nucl. Phys., 76: 479-80(Feb. 1966).

Corrections for previous M1 transitions and improved values of E2 data based on a better choice of parameters in the quadrupole operator are presented. Slight changes in the optimum values of some parameters and components of wave functions from a recalculation of copper-63 data are given. (J.F.P.)

19893 ON THE R- AND S-MATRIX THEORIES OF NUCLEAR REACTIONS. Mahaux, C. (Univ., Liege). Nucl. Phys., 79: 481-94(1966).

The Wigner-Eisenbud dispersion expansion for the collision matrix is derived without introducing the R-matrix. The corresponding one-level approximation is then discussed in the general case. A formulation of the S-matrix theory is given which does not make use of any quantity depending upon the interaction radii. It is shown that the factorization of the residues of the elements of the collision matrix at a simple pole into two partial widths is a direct consequence of the symmetry property of the collision matrix. (auth)

19894 OCTUPOLE COULOMB EXCITATION OF THE ^{208}Pb NUCLEUS. Hrynkiewicz, A. Z.; Kopta, S.; Szymczyk, S.; Walczak, T. (Inst. of Nuclear Physics, Krakow). Nucl. Phys., 79: 495-504(1966).

Ions of ^{12}C with energies of 45.5 to 60.2 Mev were used to Coulomb excite the 3^- state in ^{208}Pb. It is shown that the 2615 kev γ-ray results from Coulomb excitation of ^{208}Pb. The reduced transition probability is found to be $B(E3)\uparrow = (0.83^{+0.19}_{-0.25})e^2b^3$. (auth)

19895 LEVEL STRUCTURE OF ^{37}Ar AND ^{41}Ar. Holbrow, C. H.; Hewka, P. V.; Wiza, J.; Middleton, R. (Univ.

of Pennsylvania, Philadelphia). Nucl. Phys., 79: 505-12 (1966).

Argon gas targets containing 99.6% ^{40}Ar and 99.1% ^{36}Ar, respectively, were bombarded with 11 Mev deuterons. The emitted protons were magnetically analysed and recorded on nuclear emulsions. Measurements were made of 122 proton groups corresponding to levels in ^{41}Ar below 8.3 Mev excitation energy and of 76 proton groups corresponding to levels in ^{37}Ar below 9.1 Mev excitation energy. (auth)

19896 A SHELL-MODEL CALCULATION OF THE ODD-MASS TIN ISOTOPES. Kuo, T. T. S. (Univ. of Pittsburgh); Baranger, E. U.; Baranger, Michel. Contract Nonr 760(15). Nucl. Phys., 79: 513-49(1966).

A shell-model hamiltonian with a residual two-nucleon interaction of Gaussian form is used to calculate the states of the odd-mass tin isotopes. The Bogolyubov-Valatin quasi-particle transformation is made and the residual interaction is diagonalized in a one- and three-quasi-particle space. The spurious states must be projected out. Various approximations to this procedure, such as perturbation theory and a phonon approximation, are studied. Perturbation theory is adequate for low states. The phonon approximation is correct qualitatively, but not quantitatively. The parameters of the residual interaction and the single-particle energies are determined by requiring good agreement with the experimental energies. Magnetic moments, electromagnetic transition rates, and spectroscopic factors are calculated and agree well with the experimental values. (auth)

19897 TRANSVERSE FORM FACTORS OF EXCITED STATES IN ^{16}O. Vanpraet, G. J.; Barber, W. C. (Stanford Univ., Calif.). Contract Nonr 225(67). Nucl. Phys., 79: 550-60(1966).

Experimental results are reported of the electromagnetic properties of excited states below the giant resonance in ^{16}O using 180° inelastic scattering of electrons with incident energies of 43, 59, and 69 Mev. A comparison is made with the transverse form factors for inelastic electron scattering from 1^-, T = 1 states, calculated by Lewis, and from 2^-, T = 1 states calculated by deForest on the basis of the particle-hole model of the nucleus. Combined with known photon absorption cross sections, the interpretation of all the available data for the 13 Mev level requires a 1^- state to account for the photon point and the 2^- state for the high q points. For the level at 17 Mev, the theory is about a factor of 2 higher than the electron scattering results. The peak observed at 20.2 Mev has a transverse form factor with a q dependence that follows within a factor of 2 the theoretical results for the strong 2^- state calculated by deForest. Properties of levels found at 11.0 and 12.0 Mev excitation are also discussed. (auth)

19898 THE BETA DECAY OF ^{24}Na. FERMI NUCLEAR MATRIX ELEMENT AND CHARGE DEPENDENCE OF NUCLEAR FORCES. Blin-Stoyle, R. J.; Yap, C. T. (Univ. of Sussex, Eng.). Nucl. Phys., 79: 561-4(1966).

It is shown that the use of Nilsson wave functions enables the magnitude of the Fermi matrix element for the ^{24}Na($J = 4^+$, $T = 1$) → ^{24}Mg($J = 4^+$, $T = 0$) β decay to be accounted for in terms of a charge dependence of nuclear forces consistent with that deduced from experimental data. (auth)

19899 LEVEL SCHEME AND GAMMA TRANSITIONS IN ^{52}V. Van Assche, P. (Technical Univ., Munich. Research Establishment, Riso, Denmark); Gruber, U.; Maier, B. P.; Koch, H. R.; Schult, O. W. B.; Vervier, J. Nucl. Phys., 79: 565-76(1966).

The thermal neutron capture gamma ray spectrum of ^{52}V was measured with the curved crystal spectrometer at the DR-3 reactor in Risø. A level scheme is constructed using the energies and intensities of capture gamma lines between 20 kev and 1 Mev. The levels are identified as the low-lying part of the configurations (proton $1f_{\frac{7}{2}}$)^3 (neutron $2p_{\frac{3}{2}}$, $2p_{\frac{1}{2}}$ or $1f_{\frac{5}{2}}$), which were studied by shell model calculations with effective proton-proton and proton-neutron interactions. The spectroscopic factors of the proton groups leading to these states in the ^{51}V(d,p)^{52}V reaction and the relative reduced M1 transition probabilities between them are satisfactorily reproduced by the calculations. (auth)

19900 BETA AND GAMMA SPECTROSCOPIC STUDIES OF 9.7-d ^{125}Sn. Auble, R. L.; Kelly, W. H. (Michigan State Univ., East Lansing). Nucl. Phys., 79: 577-92(1966).

The energy levels in ^{125}Sb populated in the decay of 9.7 d ^{125}Sn were studied using β- and γ-ray spectroscopy techniques. Single and coincidence γ-ray spectra were recorded using both NaI(Tl) and Ge(Li) detectors. The high resolution of the Ge(Li) detectors was used to identify 24 gamma-ray transitions in this decay and coincidence studies suggest the presence of three other weak or unresolved transitions. The observed transitions and coincidence relations led to the assignment of excited states in ^{125}Sb at 1017.2, 1066.9, 1089.0, 1350.3, 1419.8, 1806.9, 1890.6, 1982.0, 2002.0, 2199.7, 2240.0, 2276.0 and 2288.0 kev. Angular correlation measurements of some of the prominent γ-γ cascades were made and the results used in conjunction with log ft values to limit the possible spin assignments for several of the states. (auth)

19901 PROTON-NUCLEI CROSS SECTIONS AT 20 Gev. Bellettini, G.; Cocconi, G.; Diddens, A. N.; Lillethun, E.; Matthiae, G.; Scanlon, J. P.; Wetherell, A. M. (CERN, Geneva). Nucl. Phys., 79: 609-24(1966).

Measurements of the differential cross section of 20 Bev protons scattered elastically and quasi-elastically by a series of nuclei, ranging from Li to U, are presented. The total and the elastic cross sections are also given. The light nuclei show, at the smallest angles, the characteristic central diffraction peak produced by an absorbing disc; at larger angles the quasi-elastic scattering produced by single nucleons predominates. The heavy nuclei exhibit diffraction rings up to the largest angles explored (≈20 mrad). The diffraction patterns are interpreted with an optical model that takes into account the contribution of both the nuclear and the Coulomb interactions. The radii of the heaviest nuclei turn out to be consistently larger than those deduced from electron scattering experiments. The opacity is found to be nearly complete only in the heaviest nuclei. Results at the largest angles measured show that only a small fraction of the nucleons in the nuclei can act as effectively independent scattering centers. (auth)

19902 STUDY OF THE ^{39}K(p,α)^{36}Ar REACTION. Von Ehrenstein, D.; Meyer-Schuetzmeister, L.; Allas, R. G. (Argonne National Lab., Ill.). Nucl. Phys., 79: 625-39(1966).

The reaction ^{39}K(p,α)^{36}Ar was investigated in the incident proton energy range 10.0–13.0 Mev in steps of 20 kev and 100 kev at eight angles from 25 to 160°. The excitation functions of the α-groups leading to different final states in ^{36}Ar exhibit strong fluctuations in forward and backward angles. These fluctuations usually are not correlated. The analysis was made in terms of the Ericson statistical model. The coherence width Γ is around 10–15 kev. There are some indications for non-fluctuating contributions (direct interaction). Tentative spin assignments of the first two excited states in ^{36}Ar are discussed on the basis of the 2I + 1 rule. (auth)

19903 THE ABSORPTION OF NEGATIVE PIONS BY COPPER. Cheon, Il.-T. (Kyoto Univ.). Nucl. Phys., 79: 657-63(1966).

Recently it was pointed out that the absorption of stopped negative π mesons could provide useful information on nuclear structure and now many experiments are under way to take advantage of this. The energy spectrum of neutrons emitted after negative pion capture from copper has been calculated by the quasi-free scattering model and compared with the experimental data. (auth)

19904 MEASUREMENT OF NARROW-ANGLE SCATTERING OF 14.4-kev GAMMA RAYS BY THE MOESS-

BAUER EFFECT. Champeney, D. C.; Woodhams, F. W. D. (Univ. of East Anglia, Norwich, Eng.). Phys. Lett., 20: 275-7(Feb. 15, 1966).

Experiments are described showing that the Mössbauer effect may be used to measure the multiple small angle scattering of 14.4 kev gamma rays off inhomogeneous materials at angles of about 10^{-5} radians. (auth)

19905 FINE STRUCTURE OF ISOBARIC ANALOGUE RESONANCES IN ^{41}K. Keyworth, G. A.; Kyker, G. C. Jr.; Bilpuch, E. G.; Newson, H. W. (Duke Univ., Durham, N. C.). Phys. Lett., 20: 281-4(Feb. 15, 1966).

Almost all single ^{40}Ar(p,p) resonances near 1.87 and 2.45 Mev are interpreted as fine structure of the isobaric analogs of the fourth ($J\pi = 3/2^-$) and sixth ($J\pi = 1/2^+$) excited states of ^{41}Ar; few strong resonances are observed between these energies. (auth)

19906 A TEST FOR TIME-REVERSAL INVARIANCE IN NUCLEAR FORCES. Kajfosz, J.; Kopecky, J.; Honzatko, J. (Nuclear Research Inst., Prague). Phys. Lett., 20: 284-6(Feb. 15, 1966).

Cascade transitions of nuclei oriented by polarized neutron capture were used to examine the possibility of increasing the accuracy of time-reversal invariance tests. The cascade produced in titanium-49 by thermal neutron capture in titanium-48 was used. The results of these experiments gave a value of the time-noninvariant part of the hamiltonian of nuclear forces of less than 2% of the full hamiltonian. (J.F.P.)

19907 ANGULAR DISTRIBUTION OF ALPHA PARTICLES FROM THE ^{10}B(^{3}He,α)^{9}B REACTION. Carpenter, R. T.; Hiddleston, H. R. (Univ. of Iowa, Iowa City). Phys. Lett., 20: 286-7(Feb. 15, 1966).

The angular distribution of the ground state alpha particles from the ^{10}B(^{3}He,α)^{9}B reaction was measured at a bombarding energy of 5.50 Mev. A strong backward peak is observed, suggesting significant contributions from a direct exchange mode. The implications of this result on the possible formation of a low lying positive parity state in ^{9}B are discussed. (auth)

19908 STUDY OF THE ^{13}C(^{3}He,γ_0)^{16}O REACTION IN THE REGION OF THE GIANT DIPOLE RESONANCE. Puttaswamy, N. G. (Stanford Univ., Calif.); Kohler, D. Phys. Lett., 20: 288-90(Feb. 15, 1966).

The yield of the ground-state gamma ray from the ^{13}C(He-3,γ)^{16}O reaction was studied for incident helium-3 energies between 1.0 and 3.5 Mev corresponding to excitation energies in ^{16}O between 23.60 and 25.64 Mev. Typical gamma spectra and the differential cross section at 90° for this reaction as a function of helium-3 laboratory energy are shown. Also the data are compared with the results of other experiments. (J.F.P.)

19909 A TRIPLET AT 2.8 Mev IN ^{21}Ne. Catz, A. L.; Amiel, S. (Soreq Nuclear Research Center, Yavne, Israel). Phys. Lett., 20: 291-3(Feb. 15, 1966).

A triplet of levels at 2779 ± 5, 2791 ± 5, and 2812 ± 5 kev was found in ^{21}Ne produced by the reaction ^{18}O(α,n)^{21}Ne. The presence of the triplet clarifies discrepancies observed in the branching ratio of the γ transitions from the ~2.8-Mev level of ^{21}Ne. (auth)

19910 INELASTIC SCATTERING OF α PARTICLES BY NUCLEI IN THE REGION N = 28. Bruge, G. (Centre d'Etudes Nucleaires, Saclay, France); Faivre, J. C.; Farraggi, H.; Vallois, G.; Bussiere, A.; Roussel, P. Phys. Lett., 20: 293-5(Feb. 15, 1966). (In French).

A study was made of nuclei in the region N = 28. Alpha particles from a 44-Mev cyclotron were scattered by targets of ^{46}Ti, ^{48}Ti, ^{50}Ti, ^{52}Cr, ^{54}Fe, ^{56}Fe, and ^{58}Fe. The results are presented in the framework of the collective vibrational model, in which first-order excitations can be distinguished from those of second order. The deformation lengths for the different excited levels of the nuclei studied are given. (J.F.P.)

19911 GAMMA DECAY OF THE 5.16-Mev STATE IN ^{10}B. Segel, R. E.; Siemssen, R. H. (Argonne National Lab., Ill.). Phys. Lett., 20: 295-7(Feb. 15, 1966).

A transition from the 5.16-Mev state to the 3.58-Mev state in ^{10}B was sought and found; the strength of this transition is in agreement with the theoretical predictions of Cohen and Kurath. It is shown that the entire gamma decay scheme from the 5.16 Mev level is consistent with the theory. (auth)

19912 EXCITED STATES OF ^{4}He AT ABOUT 30 Mev. Tang, Y. C. (Univ. of Minnesota, Minneapolis). Phys. Lett., 20: 299-301(Feb. 15, 1966).

Analysis of the result from the reaction ^{6}Li(π^+,2p)^{4}He shows that there are excited states of ^{4}He at about 30 Mev excitation, which can be best interpreted as having the structure of two deuteron clusters in relative oscillation. (auth)

19913 THE OBSERVATION OF AN 8^+ LEVEL IN ^{20}Ne. Kuehner, J. A.; Ollerhead, R. W. (Chalk River Nuclear Labs., Can.). Phys. Lett., 20: 301-3(Feb. 15, 1966).

An 8^+ level was identified in ^{20}Ne at 11.99 Mev. This level can be identified as the spin-8 member of a rotation-like band based on the ground state whose level positions suggest the importance of the pairing effect. (auth)

19914 THE FIRST T = 1 LEVEL IN ^{58}Cu. Harchol, M.; Jaffe, A. A.; Drory, Ch.; Zioni, J. (Hebrew Univ., Jerusalem). Phys. Lett., 20: 303-5(Feb. 15, 1966).

A new level in ^{58}Cu at 202 ± 2 kev was observed by two methods. It is identified as the isobaric analog of ^{58}Ni. Using this result a prediction is made about the stability of ^{57}Cu and its positron decay. (auth)

19915 ^{192}Ir CONVERSION LINES AND ^{192}Pt X-RAY LEVELS. Jahn, P.; Todt, W.; Daniel, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 20: 395-6(Mar. 1, 1966).

The strong conversion lines of ^{192}Ir were measured with the new high-precision $\frac{1}{2}\pi\sqrt{13}$ beta spectrometer. The deduced x-ray levels of ^{192}Pt are compared with literature values for Pt; an L_{II} anomaly is discussed. (auth)

19916 COMPARISON OF THE ELASTIC SCATTERING OF ^{3}He AND ^{4}He BY ^{40}Ca. Springer, A.; Chabre, M.; Hendrie, D. L.; Pugh, H. G. (Univ. of California, Berkeley). Phys. Lett., 20: 397-8(Mar. 1, 1966). (UCRL-16620).

The scattering of ^{3}He and ^{4}He from ^{40}Ca was compared at equal incident momenta. The results indicate that ^{3}He has a more diffuse interaction than ^{4}He. (auth)

19917 INELASTIC PROTON SCATTERING FROM ANALOGUE RESONANCES IN ^{94}Zr + p. Legg, J. C.; Crosby, M. A.; Roy, G. (Rice Univ., Houston, Tex.). Phys. Lett., 20: 399-401(Mar. 1, 1966).

A test is suggested for the application of a Breit-Wigner formula to inelastic proton scattering from analog resonances. The results of inelastic proton scattering from ^{94}Zr suggest that the structure of low-excitation Zr levels is more complex than previously supposed. (auth)

19918 THE LIFETIMES OF THE 937- AND 1082-kev STATES OF ^{18}F. Alexander, T. K.; Allen, K. W.; Healy, D. C. (Chalk River Nuclear Labs., Ontario, Can.). Phys. Lett., 20: 402-4(Mar. 1, 1966).

A 25 cc Ge(Li) detector was used in a recoil-distance method to yield lifetimes of $\tau = 68 \pm 7$ ps for the 937-kev level and 30 ± 3 ps for the 1082-kev level of ^{18}F. The E2 strength of the 937-kev transition is 5.8 ± 0.6 Weisskopf units. (auth)

19919 ISOBARIC SPIN MIXING IN ^{8}Be. Dalton, B. J.; Robson, D. (Florida State Univ., Tallahassee). Phys. Lett., 20: 405-7(Mar. 1, 1966).

The energy splittings of isobaric doublets near proton threshold in ^{8}Be are explained solely by allowing for Coulomb distortion of the proton wave functions in the

asymptotic region. These results provide further support for Marion's cluster model for the 2^+ doublet. (auth)

19920 INTERPRETATION OF FAST-NEUTRON-CAPTURE ISOMER RATIOS. Grench, H. A.; Coop, K. L.; Menlove, H. O.; Vaughn, F. J. (Lockheed Palo Alto Research Lab., Calif.). Phys. Lett., 20: 407-9(Mar. 1, 1966).

The Huizenga-Vandenbosch method of computing thermal-neutron-capture isomer ratios was extended to the case of fast-neutron capture. The theory was applied to the $^{89}Y(n,\gamma)^{90g,90m}Y$ reactions. (auth)

19921 EXCITATION OF THE GROUND STATE BAND OF ^{19}F BY 13.9-Mev PROTON SCATTERING. Lutz, H. F.; Wesolowski, J. J.; Hansen, L. F.; Eccles, S. F. (Univ. of California, Livermore). Phys. Lett., 20: 410-12(Mar. 1, 1966). (UCRL-14605).

The preferential excitation of the ground state rotational band of the ^{19}F nucleus was observed in an experiment with 13.9 Mev protons. The angular distributions are fitted with the adiabatic approximation rotational optical model. (auth)

19922 THE BEHAVIOR OF THE COMPLEX PHASE SHIFTS OVER THE 5.3- AND 6.6-Mev ANOMALIES IN $^{12}C(p,p)^{12}C$. Barnard, A. C. L.; Duval, J. S. Jr.; Swint, J. B. (Rice Univ., Houston, Tex.). Phys. Lett., 20: 412-14(Mar. 1, 1966). (TID-22552).

Complex phase shifts are obtained to represent cross sections measured over the $D_{\frac{5}{2}}$ resonance at 5.3 Mev in $^{12}C(p,p)^{12}C$. It is shown that the "resonating" phase shift does not pass through 90°. (auth)

19923 CORE EXCITATION IN ^{195}Pt. Gal (Braunstein), A. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Lett., 20: 414-16(Mar. 1, 1966).

The 99, 129, 210, and 240 kev excited states of ^{195}Pt are interpreted in terms of a core excitation model, in which also the second $(2^{+'})$ core-excited state is involved. Electromagnetic transitions and moments are analyzed within the framework of this model. (auth)

19924 PHENOMENOLOGICAL TREATMENT OF ELASTIC SCATTERING OF SPIN 1 PARTICLES BY SPIN 0 PARTICLES. Fick, D.; Hofmann, H. M. (Univ., Erlangen-Nurenberg, Ger.). Phys. Lett., 20: 416-18(Mar. 1, 1966).

With the M-matrix formalism the elastic scattering of spin 1 particles by spin 0 particles is discussed. It is shown that experiments using a polarized ion source are much more feasible than the conventional triple scattering experiments. (auth)

19925 SENSITIVITY OF A NEW (d,p) STRIPPING THEORY TO THE TRUNCATED INTERACTION. Pearson, C. A. (Australian Atomic Energy Commission, Lucas Heights. Neils Bohr Institutet, Copenhagen); Auerbach, E. H. Phys. Lett., 20: 418-22(Mar. 1, 1966).

The theory of (d,p) reactions is considered. It is concluded that in these reactions the angular distributions and polarization are not, in general, sensitive to the details of the potential cutoff. Thus it is shown that for the (d,p) reactions it usually does not matter where or how the potential is truncated. (J.F.P.)

19926 EXPERIMENTAL EVIDENCE FOR A NEW THEORY OF (t,p) AND (p,t) REACTIONS. Pearson, C. A. (Australian Atomic Energy Commission, Lucas Heights. Niels Bohr Instituet, Copenhagen); Waghmare, Y.; Auerbach, E. H. Phys. Lett., 20: 422-4(Mar. 1, 1966).

A theory of two-nucleon transfer reactions is constructed in which the proton is scattered from the proton-target interaction as if the other particles were not present. (auth)

19927 DIRECT HEAVY-ION-INDUCED EXCITATION. Morse, R. I.; Preiss, I. L. (Yale Univ., New Haven). Phys. Lett., 20: 509-11(Mar. 15, 1966).

Observation of the radionuclides ^{127}Cs through ^{132}Cs resulting from the reaction $^{133}Cs + {}^{14}N$ at 140 Mev indicates that the more neutron deficient products are formed as a result of a direct interaction mechanism followed by neutron emission. Kinematic arguments based on the recoil momenta and angular distributions indicate that the formation of a highly excited intermediate state is required to account for the formation of ^{127}Cs through ^{130}Cs. (auth)

19928 ISOBARIC ANALOG RESONANCES OF THE $^{51}V(p,\gamma)^{52}Cr$ REACTION. Teranishi, E.; Furubayashi, B. (Electrotechnical Lab. Tanashi-cho, Tokyo). Phys. Lett., 20: 511-13(Mar. 15, 1966).

In the excitation curve of the $^{51}V(p,\gamma)^{52}Cr$ reaction, 11 isobaric analog resonances were observed corresponding to low-lying states of ^{52}V. Some of the analog resonances are seen to have a certain structure which is reminiscent of the Robson theory of asymmetrically enhanced fluctuations. (auth)

19929 EXCITED STATES OF ^{48}Ca AND ANGULAR DISTRIBUTIONS IN PROTON SCATTERING. Lassen, L.; Scholz, T.; Unsoeld, H. J. (Univ., Heidelberg). Phys. Lett., 20: 516-18(Mar. 15, 1966).

Targets of ^{48}Ca were bombarded with 10 Mev protons. The inelastic particle spectra show 13 levels in ^{48}Ca below 8 Mev excitation energy. Angular distributions and DWBA calculations are given for the states at 3.818, 4.272, 4.498 and 4.604 Mev. (auth)

19930 THE FINE STRUCTURE OF ANALOG STATES IN ^{41}K AS A CONSEQUENCE OF HIGHER GENERATIONS OF STATES. Buettner, H.; Greiner, W.; Suessmann, G. (Univ., Frankfurt am Main). Phys. Lett., 20: 521-5 (Mar. 15, 1966).

The number of 2p-1h and 3p-2h configurations with $J = {}^3/_2, {}^1/_2$ and $\pi = -$ in ^{41}K was computed and compared with the number of fine structure levels of analog states. (auth)

19931 LIFETIME OF SOME LEVELS IN ^{187}Re. Petersen, K.; Trumpy, G.; Oestergard, P. (Technical Univ. of Denmark, Copenhagen). Phys. Lett., 20: 527-8(Mar. 15, 1966).

Using the delayed coincidence method the lifetime of the 686 kev and 618 kev levels was measured. The lifetime of the 625 kev level is discussed. (auth)

19932 SPATIAL SYMMETRY IN THE NUCLEAR SHELL MODEL. Garrison, John C.; Schey, Harry M. (Univ. of California, Livermore). Phys. Rev., 143: 766-71(Mar. 18, 1966). (UCRL-14512-T).

A classification scheme for jj-coupled nuclear-shell-model wave functions which is based on spatial-symmetry considerations is proposed. The wave functions are determined by diagonalizing the Majorana operator, each wave function being labeled by the corresponding eigenvalue. It is assumed that among the states with quantum number j^nTJ the one with the largest Majorana eigenvalue lies lowest in energy, and these maximum-symmetry wave functions are used in calculations of beta-decay transitions and magnetic moments for nuclei in the $1f_{\frac{7}{2}}$ shell. The beta-decay results are considerably better than those obtained with seniority wave functions or with the wave functions derived by Lawson using Elliott's generating procedure. They also compare very favorably with the results of McCullen, Bayman, and Zamick based on an interaction calculation which uses an empirically determined two-body potential. The magnetic-moment calculations are somewhat less successful; except for the seniority scheme, the other theories usually give better results. (auth)

19933 STUDY OF NUCLEON-NUCLEUS ELASTIC SCATTERING IN SECOND-ORDER MULTIPLE-SCATTERING THEORY. McDonald, F. A.; Hull, M. H. Jr. (Yale Univ., New Haven). Phys. Rev., 143: 838-52(Mar. 18, 1966).

Nucleon-nucleus scattering is studied in the energy range 95–350 Mev for targets ranging from carbon to lead. The relative importance of the first and second order terms in Watson's multiple-scattering expansion of the optical po-

tential in terms of the two-nucleon scattering matrix is investigated with the nucleon-nucleon phase parameters obtained previously. Effects of including the angular dependence of the two-nucleon amplitudes are compared with those of the second-order potential, and they are found to be equally important so that both must be included for consistency. The possibility of investigating nuclear-structure parameters, especially the two-nucleon correlation lengths brought in by the second-order potential, is considered. (auth)

19934 DIRECT INTERACTION MECHANISM IN THE IONIZATION FOLLOWING β DECAY. Weiner, Richard M. Phys. Rev., 144: 127-32(Apr. 8, 1966).

A method of estimating the contribution of the direct interaction mechanism (d.i.m.) to the ionization process in β decay is proposed. It is restricted to the same energy range $E_\beta \gg E_b$ (E_β is the kinetic energy of the β-particle, E_b is the binding energy of the atomic electron) as the conventional theory, but is based on independent information emerging from experimental impact cross-section data. Following Williams, the ionization by external impact is ascribed to two factors: (a) direct collisions, corresponding to low impact parameters; (b) glancing ("photoeffect") collisions corresponding to large impact parameters. It is assumed that the contribution of factor (a) to the ionization cross section is the same both in external impact and in β decay, and the contribution of factor (b) to the impact cross section is evaluated by means of the Weizsäcker-Williams method. By subtracting this contribution from the experimental impact cross section, the d.i.m. cross section is obtained. This procedure to the calculation of the d.i.m. ionization probabilities $P_{d.i.}$ of the following β-active isotopes: ^{22}Na, ^{32}P, ^{90}Y, ^{143}Pr, ^{23}Ne, and ^{41}Ar. In opposition to the predictions of the conventional theory, according to which $\delta \equiv P_{d.i.}/P_s \ll 1$, ($P_s$ is the shake-off probability), the results, although approximative, suggest that the K-shell ionization probabilities are affected, sometimes in a decisive manner, by the d.i.m.; for ^{90}Y $1 < \delta < 2$ and for ^{143}Pr $2 < \delta < 4$. This conclusion is in line with independent experimental results by Charpak, Suzor, and Spighel on low-energy electrons accompanying β decay. Further experiments to check this conclusion are proposed, and possible explanations of the failure of the theory are suggested. (auth)

19935 SEARCH FOR STRUCTURE IN THE FAST-NEUTRON INTERACTION WITH ^{235}U. Smith, A. B.; Whalen, J. F. (Argonne National Lab.; Ill.). Phys. Rev. Lett., 16: 525-7(Mar. 21, 1966).

The differential cross sections for neutron elastic scattering by ^{235}U were measured at 10-kev intervals from 0.4 to 0.6 Mev, and the neutron fission cross section of ^{235}U was measured from 0.36 to 0.65 Mev. The results do not substantiate the previously reported structure in the fission cross section at 0.36 to 0.65 Mev. Little evidence of structure in the elastic scattering cross section was observed. (D.C.W.)

19936 ISOTOPE EFFECT IN ^{40}Ca, ^{44}Ca, AND ^{48}Ca CHARGE DISTRIBUTIONS FROM 250-Mev ELASTIC ELECTRON SCATTERING. Van Oostrum, K. J. (Stanford Univ., Calif.); Hofstadter, R.; Noeldeke, G. K.; Yearian, M. R.; Clark, B. C.; Herman, R.; Ravenhall, D. G. Contracts Nonr 225(67); NSF GP. Phys. Rev. Lett., 16: 528-31(Mar. 21, 1966).

The results of an investigation of the charge-density difference between ^{40}Ca and ^{48}Ca are presented. The addition of eight neutrons causes pronounced changes in the proton distribution (the charge radius increases). But the charge density at the edge of the nucleus (beyond about 4F) does not increase in the manner suggested by the overall dilatation, and it is even less in ^{48}Ca than it is in ^{40}Ca. (G.O.Y.)

19937 ISOTOPE SHIFTS AND THE ROLE OF FERMI RESONANCE IN THE CO_2 INFRARED MASER. Wieder, Irwin; McCurdy, Gregor B. (Interphase Corp.-West Palo Alto, Calif.). Phys. Rev. Lett., 16: 565-7(Mar. 28, 1966).

Observations of laser actions in several P transitions of the $00^01 \rightarrow 10^00$ and $00^01 \rightarrow 02^00$ bands of $^{12}C^{18}O_2$ are presented. The contribution of Fermi resonance to the large observed isotope shift and the importance of Fermi resonance to the kinetics of the laser are discussed. (B.G.D.)

19938 INTERFERING RESONANCES IN THE ^{19}F(α,p) ^{22}Ne REACTION. Kuperus, J. (Rijksuniversiteit, Utrecht). Physica, 31: 1603-16(Nov. 1965).

Energies and strengths are reported for twenty-seven ^{19}F(α,p)^{22}Ne resonances in the E_α = 1.3–2.6 Mev region. Transitions are observed to the ^{22}Ne ground state and first excited state. A yield curve for the E_α = 1.3–3.3 Mev region is presented. Angular distributions of the ground-state protons are measured as a function of energy. The analysis in terms of the theory of interfering resonances yields the spins of fifteen resonances and the parity of five of these. Information is obtained about widths, partial widths, and reduced widths of the observed levels. (auth)

19939 DECAY OF THE 4.7 MINUTE ISOMER OF ^{118}In AND OF THE 48 SECOND ISOMER OF ^{120}In. Meyers, P.; Loebner, K. E. G. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 31: 1774-6(Dec. 1965).

The decay of the 4.7 min isomer of ^{118}In and of the 48 s isomer of ^{120}In to levels in ^{118}Sn and ^{120}Sn, respectively, was studied by means of scintillation coincidence techniques. Contrary to earlier reports, the intensity of gamma rays above 200 kev feeding the 2320-kev level in ^{118}Sn is found to be less than 1%. Relative cross sections for producing ^{116m}In, ^{118m}In and ^{120m}In with 14 Mev neutrons by (n,p) reactions were measured and compared with calculated and experimental cross sections. (auth)

19940 NUCLEAR MATRIX ELEMENTS FOR THE MIRROR BETA DECAYS OF ^{12}B AND ^{12}N. Mafethe, M. E.; Hodgson, P. E. (Oxford Univ.). Proc. Phys. Soc. (London), 87: 429-36(Feb. 1966).

The difference between the matrix elements for ^{12}B and ^{12}N due to Coulomb effects alone is calculated using a spherical Saxon-Woods potential to generate the nuclear wave functions. The result of about 5%, when combined with the effects amounting to −3%, gives a total of 2%. This is substantially less than the experimental value of 11 ± 1%. (auth)

19941 PROTON NUCLEAR REACTION CROSS SECTIONS IN NITROGEN AT 13 Mev. MacLeod, A. M.; Reid, J. M. (Univ. of Glasgow). Proc. Phys. Soc. (London), 87: 437-44(Feb. 1966).

The total cross section for all reactions in nitrogen, excluding inelastic scatters and (p,d) reactions, is found to be 182.2 ± 9.4 mb for protons of 13 Mev by a triggered cloud chamber method. The (p,α) and (p,2p) processes each contribute about 40% of this total while the (p,^{3}He) process contributes a further 15%. The (p,n) and (p,pn) contributions are each found to be less than 3%. The results are discussed in terms of the statistical compound nucleus model which is not found to provide an explanation of the large contribution from the (p,α) and (p,^{3}He) processes. (auth)

19942 LIFETIMES OF EXCITED STATES IN ^{155}Gd AND ^{191}Ir. Narasimha Rao, B. V.; Jnanananda, S. (Andhra Univ., Waltair, India). Proc. Phys. Soc. (London), 87: 455-9(Feb. 1966).

The lifetimes of the 105- and 86.5-kev levels of ^{155}Gd and 129-kev level of ^{191}Ir are measured with a fast time-to-amplitude converter. The values obtained, respectively, are $5.01 \pm 0.25 \times 10^{-10}$ sec, $5.31 \pm 0.16 \times 10^{-9}$ sec and $12.53 \pm 1.25 \times 10^{-11}$ sec. The experimental transition probabilities are compared with the theoretical estimates. In the case of ^{155}Gd a good agreement of the experimental transition probabilities with the Nilsson's estimate is observed. (auth)

19943 EFFECTIVE CROSS SECTION FOR THE REACTION ^{48}Ca(n,2n)^{47}Ca FOR NEUTRONS AT 14 TO 15 Mev AND FOR FISSION NEUTRONS. Kurchatova, L. N.; Levin,

V. I.; Morozov, L. N. Radiokhimiya, 7: 472-5(1965). (In Russian).

The effective cross sections for the reaction $^{48}Ca(n,2n)^{47}Ca$ for fission neutrons (in nuclear reactors) and for neutrons at 14 to 15 Mev were measured as 0.3 ± 0.03 mb and 0.9 ± 0.20 b, respectively. (J.S.R.)

19944 DECAY OF ^{174}Tm AND ^{175}Tm. Wien, Karl (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 191: 137-59(Feb. 1966). (In German).

The radioactive isotopes ^{174}Tm and ^{175}Tm were produced by the reactions $^{176}Yb(\gamma,np)^{174}Tm$ and $^{176}Yb(\gamma,p)^{175}Tm$ respectively, with bremsstrahlung of 54 Mev maximum energy. The β- and γ-radiations from the decay of these isotopes were investigated using scintillation counters, solid state detectors and coincidence methods. The decay scheme proposed for ^{174}Tm is similar to those proposed by previous investigations. The spin assignment of the isomeric 1520 kev level was revised to be I = 7. The decay of ^{175}Tm, which was until now rather unknown, has a half life of 15.2 ± 0.5 min. The suggested decay scheme shows excited levels at 105 ($^9/_2^-$), 511 ($^1/_2^-$), 553 ($^3/_2^-$), 598 ($^5/_2^-$), 643 ($^5/_2^-$, $^1/_2^-$), 816 ($^3/_2^-$), 873, 990, 1454 ($^1/_2^+$), 1496 ($^3/_2^+$), 1505, 1810 and 1881 kev. The results are discussed using the Nilsson model. (auth)

19945 THE GYROMAGNETIC RATIO OF THE FIRST EXCITED ROTATIONAL STATES IN $^{170,172,174,176}Yb$ [Thesis]. Tippie, John William. Cleveland, Case Inst. of Tech., 1965. 133p.

The g-factors and mean lives of the first excited rotational states in ytterbium 170, 172, 174, and 176 were measured. The measured values are: g = .326 ± .021, τ = 2.283 ± .073, for ^{170}Yb; g = .279 ± .014, τ = 2.458 ± .074 for ^{172}Yb; g = .247 ± .013, τ = 2.592 ± .075 for ^{174}Yb; g = .299 ± .015, τ = 2.543 ± .074 for ^{176}Yb. These values were obtained by the observation of the rotation of the de-excitation gamma rays as a function of time following Coulomb excitation with a pulsed proton beam. It was possible to follow the precession of the excited nuclei in a magnetic field of 34,000 gauss for about five mean lives. In this time the nuclei precessed through a net angle of about 30°. The metallic targets were found to be essentially free of quadrupole perturbations. In addition the ytterbium 2^+ ion is diamagnetic. This implies that the measured precession angle as a function of time can be interpreted as the Larmor precession frequency of the excited nuclei in the external magnetic field, and no corrections to the measured g-factor are necessary. (Dissertation Abstr.)

19946 THE PHOTODISINTEGRATION OF ^3He AT PHOTON ENERGIES OF 8.06 AND 9.17 Mev [Thesis]. MacDonald, Jack Robert. Vancouver, Can., Univ. of British Columbia, 1964. 149p.

The cross section for the photodisintegration of helium-3 was measured by gamma energies of 8.06 and 9.17 Mev. The $^3He(\gamma,p)D$ reaction cross section at 8.06 and 9.17 Mev was found to be 0.493 ± 0.066 and 0.723 ± 0.087 millibarns respectively. The $^3He(\gamma,n)2p$ reaction cross section at 9.17 Mev was found to be 0.25 ± 0.13 millibarns. These results are compared with other experimental work on the photodisintegration of helium-3 and tritium. The photodisintegration reaction was observed in a cylindrical gridded ionization chamber using a helium-3, methane, and argon gas mixture. The $^{13}C(p,\gamma)^{14}N$ reactions at proton bombarding energies of 0.554 and 1.75 Mev were used as the source of gamma rays of well defined energy. The preparation of carbon-13 targets is discussed in detail. Theoretical calculations on the photodisintegration of mass-3 nuclei are summarized. Photodisintegration and electron scattering measurements are compared as methods of determining the nature of the ground state wave function of the mass-3 system. (Dissertation Abstr.)

19947 COMPUTATIONS ON DIRECT NUCLEAR REACTIONS [Thesis]. Thaxton III, George Donald. Chapel Hill, N. C., Univ. of North Carolina, 1965. 206p.

The general formalism of direct nuclear reactions under the assumption that the reaction proceeds via a knock-out mechanism between an incident spinless particle and an emergent spin ½ particle is specialized to a S-state to S-state transition. The calculation employs distorted waves and finite as well as zero-range direct interactions. Explicit formulas for the differential cross section are presented. Computer programs were written to generate optical model distorted wave functions and phase shifts and to compute the radial integrals that appear in the theory. Several numerical calculations are presented. The $^{13}C(\alpha,n)^{16}O$ reaction at energies ranging from 12.8 to 22.5 Mev is discussed briefly with the results indicating that the reaction is predominantly a knock-out reaction. The $^{19}F(\alpha,t)^{20}Ne$ reaction is analyzed in greater detail. The results are not conclusive in establishing the knock-out mechanism but the feasibility of a complete direct reaction calculation, which avoids many of the usual approximations, is demonstrated. Several interpretations of the results of this computation are possible, and they are discussed in the final chapter. (Dissertation Abstr.)

19948 ABSORPTION OF RESONANCE SCATTERED GAMMA RAYS AS A METHOD OF MEASURING NUCLEAR LEVEL WIDTHS [Thesis]. Randall, John Del. College Station, Tex., Texas A and M Univ., 1965. 61p.

A novel method for determining nuclear level widths is used. Neutron-capture gamma rays from iron bombard a lead target. The incident 7.285-Mev gamma rays cause resonance fluorescence of the ^{208}Pb in the target. The energy of the emitted gamma rays varies continuously with the scattering angle as the result of the recoil energy imparted to the target nuclei. The maximum energy change is about 500 ev. The energy resolution is so well defined that a level width can be determined by measuring the resonance depression caused by an absorber placed in the scattered beam. The method is applied to the known level in lead and a self-absorption experiment performed. Only a portion of the resonance depression was observed since it is located near 0° and small angle Compton scattering interferes with the signal. The value observed for the width was 0.7 ± 0.2 ev, which agrees with the measurements performed by other methods. Applications of the technique are suggested, which should be of substantial value to the nuclear spectroscopist. (Dissertation Abstr.)

19949 CONTINUOUS GAMMA RADIATION ACCOMPANYING NUCLEAR BETA DECAY [Thesis]. Struzynski, Raymond Edward. Hoboken, N. J., Stevens Inst. of Tech., 1965. 65p.

The photon spectrum for internal bremsstrahlung for ^{35}S is computed. Relativistic Coulomb wave functions are used for the final states of the electron. The Green's function for the Dirac equation is computed using a potential based on a finite size nucleus of uniform charge density. The equivalence between the two methods of calculation originally proposed by Knipp and Uhlenbeck is proven. The results of our calculation agree with those of Mau. Since the present calculation includes Coulomb effects completely, the discrepancy between theory and experiment may now be attributed to either the neglecting of screening effects in the calculations or to experimental procedures. (Dissertation Abstr.)

19950 ANHARMONIC TERMS IN THE POTENTIAL ENERGY OF COLLECTIVE QUADRUPOLE MOTION OF EVEN NUCLEI. Kumar, Krishna (Michigan State Univ., East Lansing. Univ. of California, Berkeley). 16p. (CONF-651015-6). ORAU. Gmelin, AED-CONF-65-312-24.

From American Physical Society, Chicago.

A formulation of the potential energy of collective motion, which can be used for spherical nuclei as well as deformed nuclei, is outlined, together with a numerical method for solving Bohr's collective hamiltonian. In this formulation, deviations from a purely rotational spectrum can be explained using a single constant. (D.C.W.)

19951 AN APPARENT SMALL ANOMALY IN THE FT VALUE OF A SUPERALLOWED FERMI TRANSITION. Freeman, Joan M. (Atomic Energy Research Establishment, Harwell, Eng.); Jenkin, J. C.; Murray, G.; Burcham, W. E. 7p. (CONF-651043-5). ORAU. Gmelin, AED-CONF-65-320-14.

From Weak Interactions Conference, Argonne, Ill.

The β end-point energy and the half life of the ^{26m}Al $(\beta^+)^{26}$Mg decay were measured, and the ft value for the transition was calculated. The ft value obtained was in exact agreement with the previous value, but was significantly lower than the mean ft value for some other β^+ transitions between J = 0*, T = 1 isobars. (D.C.W.)

19952 15th ANNUAL CONFERENCE ON NUCLEAR SPECTROSCOPY AND STRUCTURE OF THE ATOMIC NUCLEUS, MINSK, USSR, JANUARY 25–FEBRUARY 2, 1965. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1054-1255 (July 1965). (In Russian). (CONF-650119).

Thirty-five papers are included. Separate abstracts were prepared for 34. One paper was previously abstracted for NSA: see abstract 19: 39934. (M.J.T.)

For abstracts of individual papers see: 19061–19064, 19137, 19463, 19464, and 19953–19979.

19953 ROTATIONAL STATES WITH HIGH SPIN OF SEVERAL NUCLEI. Diamond, R. M.; Lark, N. L.; Stephens, F. S.; Swiatecki, W. J. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1070-8(July 1965). (In Russian).

Results of experiments on deformed even-even rare-earth nuclei, produced by heavy-ion bombardment of rare-earth elements, are surveyed. The ^{164}Yb and ^{166}Yb conversion-electron spectra are shown. The rotational-state energies of nine even-even isotopes of Yb, Hf, and W are given and compared with calculated results of Davydov and Chaban. The predominance of even-spin positive-parity states and E2 transitions are discussed. The rotational constant A_I is given as a function of spin I for several nuclei. The dependence of the moment of inertia on the value of β, from experimental and theoretical determinations, is shown. The variation of the kinetic and potential energies with β is considered. Experimentally and theoretically determined values of the ratios of the energies of β-vibrational poles to the energies of the first-excited levels are presented for even-even isotopes of Nd, Sm, Gd, Er, Hf, Os, Th, U, and Pu. The results from the Davydov-Chaban model are found to agree with experiment in all the regions investigated. (M.J.T.)

19954 MEASUREMENT OF $\beta^+\gamma$ COINCIDENCES DURING THE DECAY ^{166}Tm → ^{166}Er. Dzhelepov, B. S.; Kaufman, V. Z.; Kraft, O. E.; Naumov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1079-82(July 1965). (In Russian).

The ^{166}Tm source was obtained from ^{166}Yb, formed in the 660-Mev proton irradiation of Ta. The coincidences between the hard component of the ^{166}Tm positron spectrum (1940 kev maximum energy) and the ^{166}Er de-excitation gamma rays were measured, using a magnetic β-γ spectrometer. The relative probabilities of β^+ decay to the ^{166}Er 0^+, 2^+, and 4^+ levels were derived, but the results did not permit the determination of the parity of the ^{166}Tm ground state. (M.J.T.)

19955 HALF LIFE OF THE 55-kev STATE IN THE ^{188}Ir ISOTOPE. Kryukova, L. N.; Kordyukovich, V. O.; Sorokin, A. A.; Rudenko, N. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1089-91(July 1965). (In Russian).

The preparation of the ^{188}Pt source is described. The coincidences between the L55 conversion electrons and the 380- and 420-kev gamma quanta from ^{188}Ir were measured using scintillation counters in conjunction with a time-amplitude converter. The lifetime of the 55-kev state was obtained by comparing the curve of the delayed β-γ coincidences with that of the instantaneous β-γ coincidences from a ^{60}Co source. A half life of $2.7 \pm 0.8 \times 10^{-9}$ sec was found. On the basis of the known mixture of multipolarities in this transition, the partial half lives of the state with respect to the radiative M1 and E2 transitions are 1.6×10^{-7} sec and 3.7×10^{-7} sec, respectively. The results are discussed in terms of the predictions of the generalized Bohr-Mottelson-Nilsson model. (M.J.T.)

19956 HALF LIFE OF ^{109}Cd. Beda, A. G.; Kondrat'ev, L. N.; Tret'yakov, E. F. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1092(July 1965). (In Russian).

Four series of measurements were carried out over a period of 285 days, using a toroidal beta spectrometer to record the intensity of the K- and L-conversion lines of the 88-kev gamma transition. The activity of a ^{241}Am control sample was also measured to correct for changes in detector efficiency. The half life of ^{109}Cd was found to be 416 ± 16 days. (M.J.T.)

19957 GAMMA-GAMMA ANGULAR CORRELATIONS IN ^{138}Pr → ^{138}Ce DECAY. Gromov, K. Ya.; Demeter, I.; Nadzhakov, E. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1093-7 (July 1965). (In Russian).

Angular correlations between the 300- and 1040-kev and the 1040- and 800-kev gammas in the de-excitation of ^{138}Ce were measured at 90, 135, and 180°, in order to check the spin-parity and multipolarity assignments of the various ^{138}Ce levels and transitions. Sample gamma spectra and gamma-gamma coincidence spectra are shown, and spin and multipolarity assignments are discussed with respect to previous theoretical results. (M.J.T.)

19958 AUGER ELECTRONS OF ^{160}Er AND ^{160}Ho. Avotina, M. P.; Grigor'ev, E. P.; Dzhelepov, B. S.; Zolotavin, A. V. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1098-1102(July 1965). (In Russian).

The ^{160}Er source was obtained by 660-Mev proton irradiation of Ta. The K-capture during the decay of ^{160}Er was determined from the intensities of Auger K-LL electrons of ^{160}Ho and ^{160}Dy in the decay of ^{160}Er and ^{160}Ho. No conclusions on the nature of electron capture in ^{160}Er could be drawn. However, the results do not contradict the previous conclusion that a second excited level of ^{160}Ho, with characteristics 0^+ or 1^+, must be introduced. (M.J.T.)

19959 COULOMB EXCITATION OF LEVELS OF ^{155}Gd, ^{161}Dy, AND ^{171}Yb. Yerokhina, K. I.; Lemberg, I. Kh.; Nabichvrishvili, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1103-6(July 1965). (In Russian).

An analysis is presented of results from an experiment in which the coincidences of γ quanta with inelastically scattered nitrogen ions were measured for the purpose of studying the Coulomb excitation of the levels of ^{155}Gd, ^{161}Dy, and ^{171}Yb. Higher collective levels of those nuclei which do not belong to the basic rotational band are discussed. Data are presented for these levels and comparisons made with different levels using the Berson calculated results. It is concluded that more detailed and accurate processing of the experimental data does not change the conclusion about the collective nature of the investigated levels of Gd, Dy, and Yb. (CFSTI)

19960 SPECTRUM OF ^{122}Sb γ RAYS. Arutyunyan, E. A.; Dzhelepov, B. S.; Khol'nov, Yu. V.; Shchukin, G. E. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1107-11 (July 1965). (In Russian).

The ^{122}Sb gamma spectrum was studied by means of a magnetic gamma spectrometer and using recoil electrons. The spectra of recoil electrons from a cellophane target and of photoelectrons from a Bi target are shown. The measured energies and intensities of the ^{122}Sb gamma rays are tabulated. The results for the four basic transitions agree with those of previous experiments. The data on the other transitions are examined. A decay scheme of ^{122}Sb into ^{122}Sn and ^{122}Te is given. (M.J.T.)

19961 CONVERSION ELECTRON SPECTRUM OF ^{146}Eu IN THE ENERGY RANGE 750 TO 1550 kev. Balalaev, V. A.; Dzhelepov, B. S.; Meshter, A.; Shestopalova, S. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1112-20(July 1965). (In Russian).

Graphs of the spectrum of ^{146}Eu conversion electrons from 710 to 1550 kev are shown. A table is given of the measured conversion-electron energies and intensities and the corresponding energy levels, together with results of previous experiments. All previously discovered lines and 25 new transitions were observed. (M.J.T.)

19962 INVESTIGATION OF α SPECTRA OF Dy ISOTOPES. Makunka, I.; Fenesh, T. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1121-6(July 1965). (In Russian).

Alpha spectra of Dy isotopes obtained in 660-Mev proton bombardment of Ta were studied, using a semiconductor spectrometer with resolution of 18 kev. Thirty-seven spectra from four Dy isotopes were obtained. The possible fine structure of the ^{153}Dy alpha spectrum was investigated. Results of measurements of alpha energies for ^{151,152,153,154}Dy and of total and alpha-partial half lives for ^{151,152,153}Dy are shown and compared with those of previous experiments. (M.J.T.)

19963 THE γ-RAY SPECTRUM OF ^{143}Ce. Arutyunyan, E. A.; Dzhelepov, B. S.; Khol'nov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1127-30(July 1965). (In Russian).

The gamma spectrum of ^{143}Ce was measured using a magnetic gamma spectrometer. The source was prepared by neutron irradiation of Ce enriched in ^{142}Ce. The spectra of recoil electrons from a cellophane target and of photoelectrons from a Bi target are shown. The energies and intensities of the ^{143}Ce gamma rays from 230 to 1295 kev are presented and compared with results of previous experiments. Six new gamma rays were found, requiring the addition of new energy levels to the ^{143}Pr level scheme. (M.J.T.)

19964 ON THE THEORY OF PHOTOSPALLATION OF LIGHTEST NUCLEI. Dzhibuti, R. I.; Mamaskhlisov, V. I.; Macharadze, T. S. (Inst. of Physics, Academy of Sciences, Georgian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1141-50(July 1965). (In Russian).

A review of experimental and theoretical studies of photosplitting of the lightest nuclei (^{3}He, ^{3}H, ^{4}He) is given. It is found that, although the existing theory of photosplitting of these nuclei is based on the form of the matrix element $(ED)_{if}$, starting with the matrix element $(JA)_{if}$ is more reasonable and would lead to elimination of much of the disagreement between theoretical and experimental results. The reactions ^{3}He(γ,p)d, ^{3}He(γ,n)2p, ^{4}He(γ,p)^{3}H, and ^{4}He(γ,p)p2n are studied from this point of view. The calculations are made using the Born approximation. Good agreement is shown between theoretical and experimental results. (CFSTI)

19965 ON THE SHAPE OF A SELF-CONSISTENT POTENTIAL. Korolev, A. M. (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1151-6(July 1965). (In Russian).

A qualitative treatment is given of the problem of determining the form of the self-consistent nuclear potential, without taking into consideration the dependence of the potential on the particle coordinate r if the shape of the magic nucleus is given. It is assumed that the interaction of the single-out particle with the remaining particles is realized by means of a sum of two-particle potentials. (M.J.T.)

19966 ENERGY LEVELS OF THE EVEN-EVEN NUCLEI. Korolev, A. M. (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1157-9(July 1965). (In Russian).

The pair correlations of nucleons in an unfilled shell are considered on the basis of a simple model. It is assumed that above the closed nuclear core there are one or two nucleon pairs in a singlet s-state and with zero spin. The excitation of the nucleus is considered as the single-particle excitation of the pairs in a potential well and the collective excitation of the nuclear core. An expression is obtained for the energy levels of this system. Simplified equations are obtained for the energy levels for a basic vibrational pole in an even-even nucleus, when the single-particle levels of the pair are not excited, for the case of the ground state, the single-phonon state, and the two-phonon states. (M.J.T.)

19967 ON THE ROLE OF THE VIRTUAL NUCLEUS EXCITATION STATES IN THE CLUSTER REPLACEMENT REACTIONS. Balashov, V. V.; Boyarkina, A. N.; Tulinov, A. F. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1160-5(July 1965). (In Russian).

A study is carried out of the qualitative regularities brought about by the contribution of excited states of a virtual (intermediate) nucleus to the cross sections of direct cluster-replacement reactions. Three variant models are considered: the traditional surface-interaction theory of Austern, Butler, and McManus, the diffraction theory of direct reactions proposed by Dar, and a generalization of the Austern-Butler-McManus theory which allows both the genealogical and the kinematic factors to be taken into consideration simultaneously. As an example, the reaction ^{11}B(α,t)^{12}C, taking place via the virtual nucleus ^{8}Be, is examined in detail. Results of calculations of the triton angular distributions and the reaction amplitudes for the reactions to the 0^+ and 2^+ states of ^{12}C are shown. Results of calculating the alpha angular distributions from the reactions ^{16}O(d,α)^{14}N and ^{16}O(p,α)^{13}N are also given. (M.J.T.)

19968 NUCLEAR MAGNETIC EFFECTS IN PAIR FORMATION BY γ QUANTA. Kerimov, B. K.; El Khabiri, Kh. A.; Abutalybov, I. M.; Alishev, S. I. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1166-71(July 1965). (In Russian).

The process of electron-positron or muon pair production by nonpolarized gamma quanta in the field of a nucleus possessing a magnetic moment is studied in the Born approximation. The differential pair-photoproduction cross section is calculated for all angular ranges and any energy values for arbitrary orientation of the magnetic moment with respect to the incident gamma beam. The cross section is averaged over all possible orientations of the nuclear magnetic moment and integrated over the angles of flight of the electron. The energy and angular distribution of the pairs are studied in detail. It is shown that consideration of the nuclear magnetic moment produces a noticeable increase of the pair-production cross section in the high-energy region and for large angles of flight. Pair photoproduction on ^{7}Li is examined as an example. (M.J.T.)

19969 SINGULARITIES IN PHOTODISINTEGRATION OF NUCLEI WITH UNFILLED SHELLS. Balashov, V. V.; Mailing, L.; Ramazanova, L. A.; Shitikova, K. V.; Yadrovskii, E. L. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1177-83 (July 1965). (In Russian).

An approximation for photodisintegration is considered which takes into account only the strong transitions, where states genealogically strongly bound with the ground state of the target nucleus play the role of hole excitations; this approximation gives the lower limit of the effects of configuration mixing. Photodisintegration of the nuclei ^{14}C and ^{48}Ca, which have small binding energy of the valence neutrons and large binding energy of the nucleons in the ^{12}C and ^{40}Ca cores, is examined. The total absorption cross sections are calculated. The spectra of dipole photoabsorption, calculated in the diagonal approximation and in the approximation taking configuration mixing into account, are shown, and an analysis of the decay of the dipole state is given. It is found that, in spite of the large difference in binding energies of the internal and valence nucleons, a compact group of levels of the giant dipole resonance is formed in the cases of both nuclei considered. (M.J.T.)

19970 ISOMER SHIFT AND STRUCTURE OF METASTABLE STATES OF NUCLEI. Belyakov, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1184-91(July 1965). (In Russian).

Investigation of the nuclear electric charge distribution and nuclear structure by means of the isomeric shift is discussed. Formulas for the isomeric shift from observations of optical spectra and the Mössbauer effect are developed. The calculation of the difference of the squares of the radii of the nuclear charge distribution in the ground and isomeric states is discussed. Results of calculations of the constant of volume isotopic mixing — analogous to the isomeric-shift constant — are given for Rb, Sr, Ru, Sn, Ba, and Xe isotopes. Results of calculations of the isomeric-shift constants are shown for Zn, Kr, Sr, Y, Zr, Cd, In, Te, Xe, and Ba isotopes. The magnitudes and signs of the quadrupole moments in the ground and excited states, necessary for characterizing the isomeric shifts using the excited-state spin and the transition type, are discussed for Ni, Zn, Sn, Te, I, and Xe isotopes. (M.J.T.)

19971 REACTION $^{30}Si(d,\alpha)^{28}Al$ AT DEUTERON ENERGIES OF 6.5 AND 6.7 Mev. Kolalis, R. P.; Nemilov, Yu. A.; Sadkovskii, V. S.; Teterin, E. D.; Denisov, A. E. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1192-6(July 1965). (In Russian).

The angular distributions of particles from the reaction $^{30}Si(d,\alpha)^{28}Al$ were measured for deuteron-beam energies of 6.49 and 6.73 Mev, using a Si surface-barrier detector. The energy spectrum of alpha particles emitted at 152° and the angular distributions for eight groups of alphas are shown. The integral cross sections of the reaction for various states of the product nucleus are given as a function of 2I + 1. An energy level diagram for ^{28}Al, including the spin assignments derived in the experiment, is presented. (M.J.T.)

19972 THE MECHANISM OF $^{12}C(d,\alpha)^{10}B$ REACTION. Nemilov, Yu. A.; Sadkovskii, V. S.; Teterin, E. D.; Denisov, A. E.; Kolalis, R. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1197-1200(July 1965). (In Russian).

The reaction $^{12}C(d,\alpha)^{10}B$ was studied for deuteron energies of 6.23, 6.49, 6.73, and 6.82 Mev. The energy spectra of alpha particles were measured at angles from 20 to 160° (lab system). The alpha angular distributions corresponding to the ground and first-excited states of ^{10}B are shown for the various bombarding energies and compared with results of previous experiments and of knock-out calculations. The angular distributions from the reaction $^{13}C(d,\alpha)^{11}B$ were also measured. It is found that the preponderant mechanism for the two (d,α) reactions is the compound nucleus mechanism. (M.J.T.)

19973 INVESTIGATION OF ^{35}Cl ENERGY LEVELS AT 8.2 TO 9.2 Mev EXCITATION. Kompanets, E. G.; Koval, A. A.; Sukhotin, L. N.; Tsytko, S. P. (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1201-6(July 1965). (In Russian).

The reaction $^{34}S(p,\gamma)^{35}Cl$ was studied at proton energies from 1.9 to 3.0 Mev. The gamma spectra were measured. Several new resonances corresponding to high-lying levels of ^{35}Cl were found, and the characteristics of the resonance levels are tabulated. Gamma spectra were measured at angles of 0 and 90° to determine the spins of the ^{35}Cl excited states. The asymmetry coefficients in the gamma angular distributions were determined and correlated with theoretically calculated variations of the asymmetry coefficients with the multipole mixing coefficients. The gamma spectra corresponding to the 8.208-Mev resonance level and the derived decay scheme, with spin-parity and multipolarity assignments, for this level are shown. (M.J.T.)

19974 ON THE CONSTRUCTION OF A CORRECT THEORY OF NUCLEAR REACTIONS WITH REDISTRIBUTION OF PARTICLES. Tsekhmistrenko, Yu. V.; Ol'khovskii, V. S. (Kiev State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1207-11(July 1965). (In Russian).

The auxiliary Hermitian initial-state hamiltonian operator whose eigenvectors are used to express a set of functions appearing in a previously developed linear singular inhomogeneous equation for the amplitude of reactions with redistribution of particles is constructed. This equation can be solved by the iteration method to obtain generalizing formulas of the distorted-wave method. The expression for the amplitude for this type of reaction is reduced to a form suitable for computer calculation. The case of a very simple particle-redistribution reaction — the (d,p) reaction on an infinitely heavy target nucleus — is used. (M.J.T.)

19975 ELECTRIC QUADRUPOLE TRANSITIONS IN ^{40}Ca. Ishkhanov, B. S.; Yudin, N. P.; Yur'ev, B. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1211-16(July 1965). (In Russian).

Shell-model calculations of the 17 ^{40}Ca E2 transitions, of the type $N \rightarrow N + 2$, were carried out, using oscillator wave functions. The 17 transitions correspond to 17 particle-hole states which form a basis on which the hamiltonian $H = H_0 + V_{ph}$ is diagonalized. The characteristic energies H_0, i.e., the energies of the null approximation, play an important role. The null-approximation energies for the ^{40}Ca transitions are shown. Expressions for the matrix elements of the particle-hole interaction are developed, for pair forces of the δ-form. Results of calculations of the reduced matrix elements for E2 transitions and the E2-absorption cross sections in the null approximation and of the reduced matrix elements and cross sections for E2 transitions for states with T = 0 and T = 1 are shown and discussed. (M.J.T.)

19976 PROBABILITY OF ELECTROMAGNETIC TRANSITIONS BETWEEN EXCITED STATES OF ODD NUCLEI. Konstantinov, B. D. (Inst. of Physics, Academy of Sciences, Ukraininan SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1217-26(July 1965). (In Russian).

Calculations of the reduced probabilities of transitions of type B(E2) and B(M1) between low-lying states of odd nuclei with $60 \leq A \leq 150$ and $190 \leq A \leq 220$ are carried out in order to confirm the correctness of the phonon treatment of collective nuclear excitations. The problem of the stationary states of a system consisting of an even-even nuclear core and an external nucleon which interacts with the surface of the core is considered. It is assumed that the angular momentum j of the external nucleon is not the integral of the motion. The number of phonons is limited to two in the solution of the Schrödinger equation, using the approximation based on the Tamm-Dancoff method. The ground state of the nucleus is represented in the form of a superposition of eigenfunctions of nondisturbed states with various angular momenta j of the particle and with angular momentum R of the surface; only the total momentum I of the level is conserved. Calculations of the reduced probabilities for B(E2) and B(M1) transitions are carried out using the wave functions of this model and taking account of the external proton. An attempt is made to interpret the low-lying states of some odd nuclei as the result of binding of a single particle of momentum j with the low-lying states of an even-even core. (M.J.T.)

19977 KNOCKING OUT α PARTICLES FROM CARBON NUCLEI. Kuz'min, V. N.; Yakovlev, R. M. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1236-41(July 1965). (In Russian).

The energy spectra of alpha particles emitted at angles of 75.5, 77.5, and 79.5° from the reaction $^{12}C(p,p\alpha)^{8}Be$ at 660 Mev were measured. The differential cross sections of this reaction and of the elastic scattering of 660-Mev protons on ^{4}He are given for the three angles; the ratio of these cross sections, which characterizes the efficiency of alpha emission from C, is computed and compared with values calculated from the shell model. The comparison shows that the emission of alpha particles from each level of the C nucleus is actually determined by the reduced widths of the residual nucleus. (M.J.T.)

19978 ELASTIC SCATTERING OF 660 Mev PROTONS ON ^{3}He AND ^{4}He NUCLEI. Kuz'min, V. N.; Yakovlev, R. M.

Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1242-7(July 1965). (In Russian).

The differential cross sections for 660-Mev proton elastic scattering on ^{3}He and ^{4}He were measured for proton scattering angles from 11 to 26° in the cms. The energy distributions of the recoil nuclei at 82.5° are shown. The results are discussed in terms of various models, considering diagrams showing nucleon scattering on the "elementary particles" ^{3}He and ^{4}He, the diagram of the scattering amplitude as the sum of the scattering amplitudes on the separate nucleons of the nuclei, and the diagram of the reaction p(He-4, NN$x\pi$)^{3}He. (M.J.T.)

19979 ON THE ELECTRIC DIPOLE TRANSITIONS FROM EVEN-EVEN NUCLEAR OCTUPOLE LEVELS. Leper, D. P. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1253-5(July 1965). (In Russian).

Lifetimes of the negative-parity octupole states in even-even nuclei, decaying by E1 transitions to lower lying positive-parity levels, are determined by calculating the reduced E1 transition probabilities from the octupole levels. An expression for the dipole moment of a nucleus possessing quadrupole and octupole deformations, obtained from representations on the polarizability of nuclei, is used. A table is given of the energies of the 2^+ and 3^- levels, the probabilities of excitation of the 2^+ level (from previous experiments) and of the 3^- level, the squares of the amplitudes of the quadrupole and octupole deformation, and the resulting octupole-level lifetime, for Pd, Cd, Sn, Te, Ce, Nd, and Sm isotopes. (M.J.T.)

19980 COMPTES RENDUS DU CONGRES INTERNATIONAL DE PHYSIQUE NUCLEAIRE, PARIS, 2–8 JUILLET 1964. VOLUME I. RAPPORTS ET DISCUSSIONS. (Proceedings of the International Congress of Nuclear Physics, Paris, July 2–8, 1964. Volume I. Reports and Discussions). Gugenberger, P. [(ed.)]. Paris, Centre National de la Recherche Scientifique, 1964. 552p. (CONF-502 (Vol.1)).

Separate abstracts are prepared for 15 of the 16 papers included. An abstract of 1 paper previously appeared in NSA as 19: 5128. (C.E.S.)

For abstracts of individual papers see: 19459 and 19981–19994.

19981 NUCLEAR FORCES. Amati, D. (Univ., Modena, Italy). pp 57-84 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

Recent developments in analysis of nucleon-nucleon interactions are presented. Topics discussed are the use of the hypothesis of charge symmetry and charge independence in simplification of data, phenomenological analysis and potentials, the S-matrix approach, the application of dispersion relations to N-N scattering, one boson exchange models, and potentials derived from the S-matrix approach. The methods of analysis are evaluated and comparisons are presented. (B.G.D.)

19982 THE STATUS OF THE FEW NUCLEON PROBLEM. Wilson, R. (Harvard Univ., Cambridge, Mass.). pp 87-97 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A collection of works on the few nucleon problem is presented. Topics discussed are nuclear interactions dominated by a final interaction, the method of simple addition of nucleon-nucleon amplitudes according to impulse approximations, derivation of real and imaginary nucleon-nucleon amplitudes from nucleon-nucleon phase shifts, and the subject of π-meson optical effects. (B.G.D.)

19983 NUCLEAR MATTER. Bethe, H. A. (Cornell Univ., Ithaca, N. Y. NORDITA, Copenhagen). pp 101-25 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A review of recent accomplishments in nuclear matter theory is presented. Topics discussed are the general theory, quasi-superconductivity in nuclei, and applications to finite nuclei. Discrepancies between the calculated (8 Mev) and the observed (16 Mev) binding energy of nuclear matter are investigated, including investigations into certain higher order terms of the Goldstone expansion. (B.G.D.)

19984 NUCLEAR STRUCTURE AND MODELS (GROUND STATE AND LOW EXCITED LEVELS): LIGHT NUCLEI. Brown, G. E. (NORDITA, Copenhagen). pp 129-48 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

Using deformation as the criteria, investigation of the upper regions of the p-shell, and the lower portion of the s and d shells is presented. Topics discussed are the rotational states in ^{16}O, states of ^{18}O, the odd parity states in ^{15}O, ^{16}O, and ^{17}O, and the states of ^{19}F, ^{20}Ne and ^{24}Mg. (B.G.D.)

19985 NUCLEAR STRUCTURE AND MODELS MEDIUM AND HEAVY NUCLEI. I. Baranger, M. (Carnegie Inst. of Tech., Pittsburgh). pp 151-80 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

Analytical methods of finding properties of many bodied wave functions by experimenting on medium and heavy nuclei are presented. The classification of these properties by analysis of the single, collective, and pairing aspects of nuclear wave functions are discussed. Description of shell model calculations are theoretically presented by the use of the two-body potential as a parameter and as a known value. Deformed nuclei are investigated utilizing the same classification of aspects of nuclear wave functions. (B.G.D.)

19986 NUCLEAR STRUCTURE AND MODELS MEDIUM AND HEAVY NUCLEI. II. Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge). pp 183-200 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

The subject of deformed nuclei, including the aluminum region, the rare earths, and the actinide region of the periodic table is presented. Topics discussed are establishment of deformations, axial symmetry, quadrupole moments, transition into and out of the strongly deformed regions, and intrinsic excitations of the deformed nuclei. Parity, conservation, and μ mesic x rays are also considered. (B.G.D.)

19987 THE THEORY OF NUCLEAR MODELS. Bloch, C. (Princeton Univ., N. J.). pp 203-23 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A general summary is presented on the theory of nuclear models and the relation between the various approaches. Discussions on invariance properties and the analog states, generalizations of independent particle models, collective variables, interactions as a perturbation, and renormalized theories are presented. (B.G.D.)

19988 REACTION MECHANISMS. RETARDED INTERACTIONS AND COMPOUND NUCLEUS: STATISTICAL THEORIES. Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). pp 227-53 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

The critical energy levels of a compound nucleus which create strong cross section fluctuations are discussed. The width of the maxima corresponds to the lifetime of the compound system. Statistical theory employing the hypothesis of maximum randomness is presented. Average reaction cross sections and average cross sections including the potential transition amplitude given by the generalized optical method are discussed. Correlations and averages are theoretically evaluated. (B.G.D.)

19989 THE OPTICAL MODEL ANALYSIS OF ELASTIC SCATTERING AND DIRECT NUCLEAR INTERACTIONS. Hodgson, P. E. (Nuclear Physics Lab., Oxford). pp 257-310 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A summary is given of recent measurements of elastic and inelastic nuclear interactions and their analysis using the optical model and direct reaction theories. (B.G.D.)

19990 APPLICATION OF DISPERSION THEORY TO DIRECT NUCLEAR REACTIONS. Shapiro, I. S. (Inst. for Theoretical and Experimental Physics, Moscow). pp 313-39 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

The dispersion method in the theory of direct processes is presented. The amplitude of a process, which is the direct study object of dispersion theory, is assumed to be an analytic function of kinematic invariants, its singularities coinciding with those of the Feynman graphs which can be drawn for the reaction under study. The formalism of the dispersion theory makes it possible to investigate the position and character of the singularities of the amplitude and then determine its behavior near physically distinct points. (B.G.D.)

19991 ELECTROMAGNETIC INTERACTIONS WITH NUCLEI. Bishop, G. R. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 343-70 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A summary of recent experimental techniques to improve resolution in energy of photonuclear experiments designed to measure the total absorption cross section directly or indirectly, or the partial cross sections composing it is presented. (B.G.D.)

19992 NUCLEAR FISSION. II. Flerov, G. N.; Polikanov, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 407-15 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A review of investigations into the processes of nuclear fission is presented. The influences of shell effects and pairing interactions between nucleons upon the processes of fission is discussed. Also under investigation are fission channels, spontaneous fission, and ternary fission. (B.G.D.)

19993 ELEMENTARY MODES OF NUCLEAR EXCITATIONS AND THEIR COUPLING. Bohr, A. (Univ. of Copenhagen). pp 487-92 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A survey of open problems in the interpretation of nuclear spectra, in terms of elementary modes of excitations and their coupling, is presented. (B.G.D.)

19994 NUCLEAR PHYSICS AND ELEMENTARY PARTICLES. Van Hove, L. (CERN, Geneva). pp 493-500 of Comptes Rendus du Congres International de Physique Nucleaire. Vol. I. Paris, Centre National de la Recherche Scientifique, 1964.

A summary on the subjects of nuclear physics and elementary particle physics and their interrelations and analogies is presented. (B.G.D.)

Plasma Physics and Thermonuclear Processes

See also Fluid Physics and Thermodynamics

Refer also to abstracts 18630 and 19693.

19995 (AD-630123) STUDY OF COLLISION PROCESSES IN GASEOUS PLASMAS. Semi-annual Technical Report No. 5. Oskam, H. J. (ed.) (Minnesota Univ., Minneapolis. Plasma Physics Lab.). Jan. 1966. Contract Nonr710(37). 7p. CFSTI $1.00 cy, $0.50 mn.

Results from simultaneous studies of the time dependence of the number density of ions and that of light emitted during the decay period of plasmas produced in helium and neon are presented. (M.O.W.)

19996 (AFCRL-66-17) MEASUREMENTS OF ANISOTROPIC PLASMAS USING A TURNSTILE MULTIPLE PROBE POLARIMETER. Scientific Report No. 2. Bachynski, M. P.; Osborne, F. J. F.; Gibbs, B. W. (RCA Victor Co., Ltd., Montreal (Quebec). Research Labs.). Oct. 1965. Contract AF19(628)-4071. 31p.

A turnstile multiple probe polarimeter was designed for plasma diagnostics at microwave frequencies. With the polarimeter it is possible to simultaneously measure the amplitude and phase of the space quadrature components of an electromagnetic wave of arbitrary polarization. This technique is thus well-suited for determining the properties of time varying or steady state anisotropic plasma. Measurements were conducted at a frequency of 9.2 Gc on a helium afterglow in a magnetic field using both linearly polarized and circularly polarized incident plane waves. The agreement of these experiments with theory indicate that the multiple probe polarimeter can be a reliable tool for plasma measurement. (auth)

19997 (CLM-R-48) A COMPUTER PROGRAM FOR FINDING COMPLEX ZEROS OF AN ARBITRARY FUNCTION. McNamara, B. (Culham Lab., United Kingdom Atomic Energy Authority, Abingdon (England)). Sept. 1965. 34p. Dep. mn. BIS $1.00. HMSO 5s.

A computer program is described which finds complex zeros of arbitrary functions by iteration from some given initial guesses. The basis of the iteration is to approximate the given function by simpler functions whose zeros can be simply calculated. The regions of the complex plane in which the iteration converges to a required zero are greatly extended by several ad hoc procedures developed in a study of helicon wave propagation. The program is constructed in such a way as to allow indefinite extension of the facilities offered without reference to the original programming. The helicon wave problem is used as an illustrative example and simple methods by which more complicated eigenvalue problems can be solved are indicated. Operating procedures are included. (auth)

19998 (CLM-R-50) A NANOSECOND SAMPLING TECHNIQUE TO AID MULTI-COIL MAGNETIC PROBE MEASUREMENTS. Godfrey, G. L. (Culham Lab., United Kingdom Atomic Energy Authority, Abingdon (England)). Oct. 1965. 6p. Dep. mn. BIS $0.30. HMSO 1s. 9d.

An electronic instrument is described which enables 32 separate input signals to be sampled in sequence in a total time of 1 microsecond, each signal being sampled for 20 nanoseconds. The 32 samples are mixed together at the output. (auth)

19999 (IPP-1/44) PLASMA LOSSES IN A TOROIDAL THETAPINCH WITH SUPERIMPOSED HEXAPOLE. Lotz, W.; Rau, F.; Remy, E.; Wobig, H.; Wolf, G. H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1966. 15p. Dep. mn.

A toroidal θ-pinch discharge with superimposed hexapole field is investigated. The characteristic data of the discharge are: 12 kG maximum field, 40 ev maximum temperature and densities of about 10^{16} cm^{-3}. The plasma loss rates are determined by measurements of particle density, temperature, and plasma radius. The measured loss rates are compared with loss rates of models which account for cusp losses, resistive losses, and others. Measured loss rates are consistent with those expected from resistive models. Furthermore, the results prove that a toroidal θ-pinch with superimposed hexapole field provides a stable toroidal high-beta equilibrium configuration at least during the times investigated and in the temperature range from 10 to 40 ev. (auth)

20000 (IPP-2/43) THE DISPERSION CHARACTERISTICS OF LONGITUDINAL PLASMA OSCILLATIONS NEAR CYCLOTRON HARMONICS. Harp, R. S. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Aug. 1965. 30p. (CONF-650806-22). Dep. mn.

From 7th International Conference on Phenomena in Ionized Gases, Belgrade.

Interest was recently focused on cyclotron harmonic waves due to their importance in several fields of plasma and ionosphere physics. The observation of anomalously high r-f radiation at harmonics of the electron cyclotron frequency in hot plasmas, as well as effects measured by topside ionospheric sounding satellites appear to be explainable in terms of cyclotron harmonic wave theory. The theory is briefly reviewed, and computed results of the hot plasma dielectric constant and dispersion relations for the waves are presented. Experimental results are presented which for the first time clearly demonstrate transmission of the waves between cylindrical probes. A complete explanation is given of the transmission characteristics between the probes which are seen to depend on the hot plasma dielectric constant as well as the freely propagating wave modes. The use of an r-f probe system is considered as a plasma diagnostic method whereby the magnetic field, plasma density, and electron temperature may be accurately evaluated. (auth)

20001 (IPP-3/36) ANFAERBEMETHODEN ZUR MESSUNG DER OERTLICHEN PLASMAGESCHWINDIGKEIT. (A New Method to Measure the Plasma Velocity by Tracing Impurity Radiation). Salzmann, H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Feb. 1966. 38p. Dep. mn.

Two methods developed for velocity measurements in steady-state plasma flows are considered. Both methods are based on the sudden introduction of a foreign substance into the plasma. The velocity is then measured by tracing the characteristic radiation emitted by the seed atoms carried with the plasma flow. The two methods differ from each other in the technique of introduction of the seed atoms into the plasma flow. In the first case, a volatile substance is evaporated from the surface of a wire immersed in the plasma. The wire is heated by a current pulse. In the second case, fine metal droplets are shot across the plasma in a direction perpendicular to that of the flow. The droplets heated by the plasma partially evaporate during their flight across the plasma. Both methods were tested in the steady-state laminar subsonic flow of a plasma jet. (auth)

20002 (LA-3442) STABILITY OF A BUMPY LINEAR, $\beta = 1$, θ-PINCH. Morse, Richard L. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Nov. 20, 1965. Contract W-7405-eng-36. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The stability of a high β cylindrical plasma of variable radius, $r = a(z)$, is treated with the approximation that the plasma and field are separated by a thin, perfectly conducting surface. In the equilibrium condition $B_\theta = 0$ and the plasma is Maxwellian. For surface modes of the form $r = a(z) + \epsilon_0(z) \cos m\theta\, e^{t/\tau}$, the perturbed magnetic field pressure is obtained with the further assumption that $|a'|$, $|aa''| \ll 1$. The perturbed plasma pressure is taken from previous calculations based on the model in which particles travel in straight lines and bounce specularly at the plasma surface. The requirement of pressure balance at the perturbed surface leads to a normal mode equation for the surface which shows instabilities caused by regions of "bad curvature," i.e., $a'' < 0$. For $a(z) = \bar{a} + \delta a \cos kz$ and $|\delta a/\bar{a}| \ll 1$, analytic expressions for growth rates are obtained. The most unstable modes are those which have a long wavelength along the cylinder axis. (auth)

20003 (N-65-16442) NICHTTHERMISCHES PLASMA UND ELEKTRISCHE LEITFAHIGKEIT. (Nonthermic Plasma and Electric Conductivity). Wahle, P. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Porz (West Germany). Institut fuer Energiewandlung und Elektrische Antriebe). Aug. 1964. 54p. (DLR-FB-64-13; DVL-304). ZLDI, Munich 13 DM.

The results of an investigation of the behavior and electric conductivity of plasmas in electric and magnetic fields are presented. (D.C.W.)

20004 (N-65-16489) THE NORMAL MODE APPROACH TO THE SOLUTION OF THE INITIAL VALUE PROBLEM FOR PLASMA OSCILLATIONS. Scientific Report No. 196, Bolduc, P. E. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Oct. 10, 1963. 103p. (NASA-CR-52405). CFSTI $4.00 cy, $0.75 mn.

The first-order determination of the properties of a plasma immersed in a constant, external, magnetic field is carried out. Normal-mode analysis is used in an initial-value problem based on plane symmetry. Methods for determining expansion coefficients for the transverse and longitudinal modes are deduced. (STAR)

20005 (N-65-19889) EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA. Quarterly Report No. 3, September 11-December 10, 1964. Malmberg, J. H.; Wharton, C. B. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Dec. 22, 1964. Contract NAS7-275. 7p. (NASA-CR-57434; GACD-6009). CFSTI $1.00 cy, $0.50 mn.

The elimination of the helix and the use of probes to initiate cyclotron waves in a collisionless H_2 plasma resulted in the cataloging of three distinct plasma waves between the electron cyclotron frequency and the upper hybrid frequency. The two waves above the cyclotron frequency constituted a fast forward wave of $v_\phi > c$, and a slow wave with a phase-retarding frequency. The effects of various plasma densities and cyclotron frequencies on the cyclotron family of waves are represented on graphs. (STAR)

20006 (N-65-19896) EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA. Quarterly Report No. 2, June 11-September 10, 1964. Malmberg, J. H. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Sept. 22, 1964. Contract NAS7-275. 5p. (NASA-CR-57437; GACD-5716). CFSTI $1.00 cy, $0.50 mn.

The design of an antenna in the shape of a helix surrounding the plasma column is reported. The antenna acts as a slow wave structure for the transmitter signal. Also the dispersion relation observed for waves near electron cyclotron frequency is given. The plasma frequency in this case is less than the electron cyclotron frequency. (STAR)

20007 (N-65-22196) LOW-FREQUENCY IMPEDANCE CHARACTERISTICS OF A LANGMUIR PROBE IN A PLASMA. Internal Memorandum. Crawford, F. W.; Grard, R. (Stanford Univ., Calif. Microwave Lab.). Feb. 1965. 30p. (NASA-CR-62131; ML-1294). CFSTI $2.00 cy, $0.50 mn.

Measurement of the l-f impedance of a Langmuir probe in a plasma can give the local electron density and temperature. Such diagnostic methods have been employed in ionospheric probing, but the interpretation of the results based on simplified theory has not been entirely satisfactory. Laboratory plasma studies designed to investigate the validity of the simplified theory are described. Good agreement is obtained between results obtained by two different impedance techniques, and conventional Langmuir probe data reduction. It is concluded that the methods could provide additional methods of measurement in laboratory plasmas, with some inherent advantages, but that a more detailed theory and extensive experimental verification are required before they can be applied with confidence to more complicated conditions in the ionosphere. (STAR)

20008 (N-65-22329) THE STABILITY OF THE POISEUILLE PLASMA ARC IN AN AXIAL MAGNETIC

FIELD. Yuen, Man-chuen (Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.). Nov. 1964. 139p. (TR-11).

The nature of the instability of the positive column of the Poiseuille plasma arc in a uniform axial magnetic field was studied. The arc was disturbed to get the magnitude of the axial magnetic field at neutral stability, and the decay or amplification of the disturbance as it moved downstream was observed by photomultipliers of adequate sensitivity and time response. The neutral stability was defined as the condition in which the disturbance remained stable. The arc current ranged from 60 to 140 amp and the flow rate from 0.04 g/sec to 0.12 g/sec. It was found that the critical axial magnetic field of the naturally excited oscillation is higher than the minimum critical magnetic field of the neutral stability for the same arc current and flow rate. Wavelength measurements show that the phase velocity is dispersive. A linearized stability theory was developed from the discontinuous model. It was concluded that thermal stabilization alone is not enough to stabilize the arc and that viscous damping plays an important role. (STAR)

20009 (N-65-22617) INVESTIGATION OF ION BEAM DIAGNOSTICS. Final Report. Sellen, J. M. Jr.; Kemp, Robert F. (TRW Space Technology Labs., Thompson Ramo Wooldridge Inc., Redondo Beach, Calif.). Apr. 15, 1965. Contract NAS3-4114. 138p. (NASA-CR-54147; STL-4137-6018-SU-000).

The results of a research program designed to investigate ion-beam diagnostics are presented. Studies of plasma wind tunnel techniques, experiments on the in-line mercury optical resonance probe, an analysis of flight-test data from the SERT-I spacecraft, and sensitivity tests of the flight model E-field meter from the SERT-I spacecraft are described. (STAR)

20010 (N-65-23211) SPECTROSCOPIC INVESTIGATIONS OF PLASMA PROPERTIES. Quarterly Summary Report No. 2, August 11-November 10, 1964. Report No. 4038. Schneider, R. T.; Myers, F. G. (Allison Div., General Motors Corp., Indianapolis, Ind.). Dec. 9, 1964. Contract NASw-922. 36p. (NASA-CR-62588). CFSTI $2.00 cy, $0.50 mn.

The performance of the plasma source operated with helium is described. Intensity and temperature profiles of the source are included. A picture of the source taken in the light of different lines is shown. The dependence of the core temperature of the arc on the arc current is shown. The electronic instrumentation for detecting weak spectrum lines is described. (STAR)

20011 (N-65-25265) COLLISIONS AND NONLINEAR EFFECTS IN PLASMAS [Thesis]. Dolinsky, Adrian Anatol (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). May 7, 1965. 154p. (NASA-CR-63162). CFSTI $5.00 cy, $1.50 mn.

Nonlinear and collision effects in the behavior of plasmas are investigated for an electron gas embedded in a neutralizing, uniformly smeared background of positive charge. Nonlinearity enters into the description of the behavior of a plasma through the collision term (arising from interparticle correlations) and the self-consistent electric field term (the ensemble average of the sum of Coulomb fields of all of the plasma particles) in an exact kinetic equation. It is impossible (at the present time) to treat both nonlinear terms simultaneously. The effect of the collision term on the behavior of a spatially homogeneous plasma is investigated first, after which the self-consistent electric field term is treated under conditions which permit the collision term to be dropped. (STAR)

20012 (N-65-27813) DETERMINATION OF PLASMA TEMPERATURE AND ELECTRON DENSITY DISTRIBUTIONS USING MILLIMETER WAVES. Leonard, William F. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). July 1964. 12p. (NASA-TN-D-2892). CFSTI $1.00 cy, $0.50 mn.

A method for obtaining good spatial resolution in the measurement of electron density and temperature variations in a thermal plasma of cylindrical cross section using millimeter waves is described. The technique, which is an application of the Abel inversion technique, involves the division of a plasma into concentric zones and the evaluation of the attenuation constant in each zone from measured attenuation losses. The results of measurements made on a cyanogen oxygen flame at 61.2 Bc are given, and correlation of the peak temperature (4470°K) at the center of the flame with spectroscopic measurements is shown. (STAR)

20013 (NASA-TN-D-3361) RADIOFREQUENCY POWER TRANSFER TO ION-CYCLOTRON WAVES IN A COLLISION-FREE MAGNETOPLASMA. Sigman, Donald R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1966. 24p. CFSTI $0.35 cy, $0.50 mn.

With the Fourier integral theory developed by T. H. Stix, calculations were made on power transfer from a radio-frequency coil to an ion-cyclotron wave in a cold collisionless cylindrical plasma. The effects of varying parameters such as static magnetic field, electron density, radiofrequency, plasma and coil radius, and wavelength are discussed. It is shown that there is an optimum radiofrequency coil wavelength for maximum power transfer, and curves are presented to facilitate the selection of this wavelength. The importance of placing the radiofrequency coil as close to the plasma as possible is also shown. Finally, a comparison is made between calculations from the above mentioned Fourier integral theory and a former Fourier-Bessel series theory (also developed by Stix). The two theories are not found to be in agreement. (auth)

20014 (NP-15938) THE MAGNETO-KERR EFFECT AT A PLASMA SURFACE. Robinson, L. C. (Sydney Univ. (Australia). School of Physics). Dec. 1965. 10p. (ER-17). Dep. mn.

Reflection at an anisotropic plasma surface changes the polarization of an electromagnetic wave from linear to elliptical. This magneto-Kerr effect is calculated and detected experimentally when two orthogonal components of a reflected microwave beam are studied. (auth)

20015 (NP-15940) WILLS PLASMA PHYSICS DEPARTMENT TENTH SIX-MONTHLY PROGRESS REPORT, JULY 1-DECEMBER 31, 1965. (Sydney Univ. (Australia). School of Physics). 8p. (PR-10). Dep. mn.

Brief comments on research on plasma sources, $J \times B$ ionization front studies, compressional wave studies, giant Alfven waves, microwave interferometry at 2 mm, magneto-Kerr effect, and lasers are included. (M.O.W.)

20016 (NYO-2813-35) CROSS-FIELD DIFFUSION OF QUIESCENT POTASSIUM MAGNETOPLASMAS. Wolf, N. S.; Rogers, K. C. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Mar. 1966. Contract AT(30-1)-2813. 28p. (SIT-179). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

It was shown by means of a technique that measures volume loss processes directly that a potassium "Q" plasma of temperature T = 2300°K, density 3.5×10^{10} to 6×10^{10} cm^{-3}, diffuses across the confining field 1 kgauss $\leq$ B $\leq$ 4 kgauss according to classical binary collision theory when the plasma is quiescent (plasma potential fluctuation $\leq$ 3% kT). The diffusion coefficient is proportional to B^{-2} to a high degree of accuracy. (auth)

20017 (NYO-2813-36) ANNUAL REPORT [ON PLASMA PHYSICS], FEBRUARY 1966. Rogers, Kenneth C. (Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics). Contract AT(30-1)-2813. 11p. (SIT-180). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The relations between microinstabilities and cross-field plasma diffusion in low-β highly ionized magnetoplasmas were investigated using Q machines. Techniques were developed for the measurement of diffusion, and the effects of beam-plasma instabilities on diffusion was studied. (D.C.W.)

20018 (TID-22785) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Annual Progress Report No. 1.

Lashinsky, H. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Mar. 1, 1966. Contract AT(40-1)-3405. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The design of an improved version of a thermal plasma device or "Q-machine," in which plasma instabilities will be studied, is described. A brief discussion of the theory of plasma oscillations in the Q device is presented. (M.O.W.)

20019 (UCRL-14511-T(Rev.1)) SATURATING PULSE TRANSFORMER WITH OPTIMIZED OUTPUT FOR A SOLENOID LOAD. Aaland, K. (Lawrence Radiation Lab., Univ. of California, Livermore). Oct. 15, 1965. Contract W-7405-eng-48. 22p. (CONF-660509-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Presentation at IEEE Components Conference, Washington, D. C.

The design of a pulse transformer capable of delivering a 10,000-ampere pulse with other highly optimized characteristics for the benefit of the load is described. The pulse is to energize a minimum mass solenoid for a 4-μsec use period. 4 μsec each are allowed for risetime and falltime of the current pulse, limiting "on" voltage to +20 kv and "off" voltage of –20 kv. Factors which had to be considered in such a transformer are described. These factors included obtaining extremely low saturated inductance and reverse coupling during saturation. Experimental results and ball-park design formulas are given. (auth)

20020 FARADAY EFFECT IN A PLASMA. Porter, W. S.; Bock, E. M. Jr. (Bucknell Univ., Lewisburg, Pa.). Amer. J. Phys., 33: 1070-3(Dec. 1965).

A treatment of the Faraday effect in an anisotropic plasma is presented. The plasma is treated as a fluid in which collisions may occur. Relations are derived for the rotation of the plane of polarization and the ellipticity of the electromagnetic wave in terms of parameters associated with the plasma. (auth)

20021 ON NONLINEAR COUPLING BETWEEN LONGITUDINAL AND TRANSVERSE WAVES IN A PLASMA. Leven, R. (Univ., Greifswald, Ger.). Ann. Phys. (7), 16: 235-41(1965). (In German).

The interaction in a plasma between a transverse electromagnetic wave and a longitudinal wave amplified by means of an electron beam was investigated. In the absence of all external mechanisms causing a coupling, such as magnetic fields and density gradients, a coupling between both waves occurs in the nonlinear approximation that leads to the origin of a new electromagnetic wave whose frequency is equal to the sum of the frequencies of the two original waves. In the nonrelativistic approximation, an expression for the amplitude was derived, which shows that these can attain at low electron temperatures in the beam the amplitude of the primary electromagnetic wave, whereas they remain essentially smaller with significant thermal movement of the beam electrons. (tr-auth)

20022 MICROWAVE REFLECTION MEASUREMENT OF HIGH ELECTRON DENSITIES OF PLASMAS PRODUCED BY SHOCK WAVES. Takeda, Susumu; Funahashi, Akimasa (Nagoya Univ., Japan). Appl. Phys. Lett., 8: 105-6(Mar. 1, 1966).

Argon plasmas produced by electromagnetically driven shock waves of Mach number 10 to 25 at a pressure of 1.0 mm Hg are measured by a 35-Bc microwave reflection probe, which is perpendicularly inserted into the shock tube. The measured values of the electron densities from 10^{13} to 10^{17} cm^{-3} are compared with those theoretically calculated. The electron density, both measured and calculated, is plotted against the Mach number, and the electron density profile for different Mach numbers is shown. The supercritical densities are measured by the phase angle of the reflection coefficient of the wave at the sharp plasma boundary, which is produced in contact with a mica plate at the probe end. (J.F.P.)

20023 CHARGED PARTICLE MOTION IN A TIME-DEPENDENT AXIALLY SYMMETRIC MAGNETIC FIELD. Seymour, P. W. (Univ. of Adelaide); Leipnik, R. B.; Nicholson, A. F. Austral. J. Phys., 18: 553-65(Dec. 1965).

Following a short review of the drift theory of plasma radial compression, an exact solution for the motion of a charged particle in an axially symmetric time-dependent magnetic field is obtained. The method gives forms for the cylindrical coordinates r and θ of the charged particle that have a simple interpretation, the z-motion being of constant velocity. As examples, the exact results are discussed for a simple power law and an exponential time dependence of the magnetic field and, using the latter results, the drift theory of plasma radial compression is qualitatively verified. (auth)

20024 ELECTRON TEMPERATURES IN HOT ARGON–POTASSIUM DISCHARGES. Sakuntala, M. (Atomic Energy Research Establishment, Harwell, Eng.). Brit. J. Appl. Phys., 17: 191-5(Feb. 1966).

The mean electron energy in argon–potassium plasma at elevated gas temperatures (1000–1300°K) and at high gas pressure (1 atm) was obtained from the analysis of floating double-probe curves. Because of the potassium vapor deposit on the probe surface, considerable thermionic electron emission takes place. As a result, the probe curves straighten so that neither the ion saturation current nor the electron temperature can be determined any longer. These curves can, however, be used for estimating the electron temperature by comparing them with a standard curve obtained at a known electron temperature which is equal to the gas temperature when the discharge is absent. Thus the ratio of the electron temperatures equals the ratio of the slopes of two probe curves. (auth)

20025 ION DISTRIBUTION IN THE PLASMA OF A VACUUM SPARK. Alexander, E.; Feldman, U.; Fraenkel, B. S.; Hoory, S. (Hebrew Univ., Jerusalem). Brit. J. Appl. Phys., 17: 265-6(Feb. 1966).

A general method of differentiation between spectral lines emitted by ions of various degrees of high ionization is described. The different distributions of these ions in the vacuum spark plasma may be plotted. (auth)

20026 NONLINEAR KINETIC EQUATION FOR THE WAVES AND THE PARTICLES FOR A HOMOGENEOUS NON-ISOTROPIC PLASMA. Andreewsky, Alexandre (EURATOM-CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. B, 262: 19-22(Jan. 3, 1966). (In French).

A nonlinear kinetic equation in a nonisotropic homogeneous plasma where the anisotropy is due to a constant magnetic field is deduced. An equation established previously in which the concepts of probability of emission and absorption of waves by the particles were introduced is used. These probabilities are calculated by a classical perturbation method using the Vlasov equation and the test particle method. The plasma model used assumes the existence of a significant background. Moreover, the perturbation made in order to calculate the probabilities is such that the particle-wave interactions can be assumed to agree with the Einstein absorption-emission model. (tr-auth)

20027 OHM'S LAW FOR A NON-NEUTRAL INHOMOGENEOUS PARTIALLY IONIZED GAS. Dolique, Jean-Michel (Faculte des Sciences, Grenoble, France. EIE, Grenoble, France). Compt. Rend., Ser. B, 262: 120-2 (Jan. 10, 1966). (In French).

The electric conductivity of partially ionized inhomogeneous plasmas in the presence of a magnetic field was studied previously. An Ohm's law more general than that given by Cowling was deduced. This law was extended to plasmas where, as a result of inelastic collisions, particles arise or disappear in the volume. In both previous studies the medium studied was a plasma or a completely neutral ionized gas. An Ohm's law for non-neutral ionized gases is established. (tr-auth)

20028 STUDY OF THE ELECTROSTATIC CHARACTER OF IONIC CYCLOTRON OSCILLATIONS. Perulli, Mariano; Etievant, Claude; Olivain, Jack (EURATOM-CEA,

Fontenay-aux-Roses, France). Compt. Rend., Ser. B, 262: 181-4(Jan. 17, 1966). (In French).

A probing of the electromagnetic field appearing in the ion cyclotron instabilities observed in the E.O.S. device made it possible to determine the wave structure (longitudinal wave length, azimuthal wave number, and radial profile of the scalar potential) and to show its quasi-electrostatic character ($|\nabla \times \overline{E}| \ll |\nabla \cdot \overline{E}|$). (tr-auth)

20029 SELF-PINCH PHENOMENA IN A LINEAR DISCHARGE OF NON-CYLINDRICAL REVOLUTION. Watteau, Jean-Paul. Compt. Rend., Ser. B, 262: 252-5 (Jan. 24, 1966). (In French).

By modification of the boundary conditions of a classical linear discharge by an appropriate shape of the insulated receptacle containing it, the radial compression of matter in an axial transport was partially transformed. These two effects contribute to the creation of a high-density quasi-spherical plasma. A theoretical interpretation is proposed. (tr-auth)

20030 ELECTROSTATIC STABILITY OF CYLINDRICAL PLASMA BEAMS. Canobbio, Ernesto (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Compt. Rend., Ser. B, 262: 347-50(Jan. 31, 1966). (In French).

The electrostatic stability of a cylinder (or a cylindrical layer) of plasma of finite radius consisting of electrons rotating around lines of magnetic force with a high perpendicular velocity and of ions displaced along the magnetic field is studied. (tr-auth)

20031 EFFECT OF AN ALTERNATING ELECTRIC FIELD ON WEAKLY IONIZED ARGON. MODULATION OF THE TEMPERATURE AND PRODUCTION OF HARMONICS. Delcroix, Jean-Loup; Pointu, Anne-Marie (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. B, 262: 351-4(Jan. 31, 1966). (In French).

The heating of electrons causes nonlinear effects which are shown by the production of odd harmonics. By distinguishing two cases according to the order of magnitude of the pulsations with respect to a relaxation frequency characteristic of the temperature, the ratio j_3/j_1 of the third harmonic to the fundamental current can be calculated. (tr-auth)

20032 NONLINEAR INTERACTION OF TWO ELECTROMAGNETIC WAVES IN A GASEOUS PLASMA. Blachier, Bruno; Delcroix, Jean-Loup; Leiba, Eugene (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. B, 262: 472-5(Feb. 14, 1966). (In French).

The nonlinear interaction of two plane electromagnetic waves was observed in a gaseous plasma. The wave created at the sum frequency is propagated effectively in the resonance condition indicated in the geometric equality of the propagation vectors. The level of the scattered wave corresponds correctly to that calculated by the classical theory of the nonlinear effect of an attenuated gaseous plasma. (tr-auth)

20033 SIMPLE METHOD FOR CALCULATION OF DEVIATIONS FROM THERMODYNAMIC EQUILIBRIUM OF A PLASMA. Binh-Dy, Hoang; McCarroll, Ronald (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. B, 262: 476-8(Feb. 14, 1966). (In French).

A simple method for the calculation of the deviations of a hydrogen plasma from thermodynamic equilibrium is described. The processes involving the high levels of the atom are fully taken into consideration. The results obtained for the case of an optically thin plasma are in very good agreement with the results from other much more complex calculations. (tr-auth)

20034 RADIATION OF A FINITE VOLUME OF UNBALANCED PLASMA. Abramov, V. A.; Kogan, V. I. Dokl. Akad. Nauk SSSR, 164: 1008-11(Oct. 11, 1965). (In Russian).

The problem of the radiation losses of a finite volume of plasma under consideration of nonequilibrium conditions and the reabsorption of the radiation has been solved by the direct calculation of the emitted quantum flux $Q(\omega)d\omega$ and by the determination of the intensity $I_\omega(r)$ on the basis of radiative transfer. It was attempted to show that the first method, developed by R. Post, which has been considered less suitable for calculating limited volumes of plasma, yields a simpler and more convenient mathematical solution if suitably handled; it is sufficient to determine the integral flux N of the emitted quanta. The derivation is based on the transfer of the isotropic radiation in a two-dimensional model, making the usual assumptions concerning homogeneity of the temperature, electron and atomic density. Volume emission by a homogeneous source was considered. Special boundary correction formulas must be used for precise limits. (TTT)

20035 ELECTROMAGNETIC WAVE RADIATION DURING NON-LINEAR INTERACTIONS OF SURFACE OSCILLATIONS IN A TWO-DIMENSIONAL PLASMA LAYER. Ryutov, D. D. Dokl. Akad. Nauk SSSR, 164: 1273-6(Oct. 21, 1965). (In Russian).

In a confined electron plasma surface oscillation also takes place in addition to volume oscillations; the electric field of these surface oscillations decreases exponentially in both directions from the boundary. The frequency of the short-wave surface oscillations is $\omega_0/\sqrt{2}$, where ω_0 designates the electron plasma frequency of the volume oscillations. The emission of the nonlinear interaction of the surface oscillation possesses a twice higher frequency, or $\omega_0\sqrt{2}$. The contribution of this emission to the electromagnetic radiation was estimated. The problem was solved for the case of a plane, 2a thick plasma layer which fulfills the inequality $a < c/\omega_0$, whereby c is the speed of light. The calculations indicate that in the electromagnetic spectrum emitted by the confined plasma, frequencies of $2\omega_0$, $\omega_0\sqrt{2}$ and $\omega_0(1 \pm 1/\sqrt{2})$ will be present. If the energy of the oscillations is uniformly distributed throughout the degrees of freedom, the intensities of these frequencies will be within one order of magnitude. This conclusion must be experimentally verified. (TTT)

20036 A QUASISINGLE PARTICLE APPROXIMATION IN COULOMB'S PROBLEM OF MANY PARTICLES. Krasko, G. L. (Bardin Central Scientific-Research Inst. of Ferrous Metals, USSR). Dokl. Akad. Nauk SSSR, 164: 298-300(Sept. 11, 1965). (In Russian).

In spatially homogeneous pinch systems of interacting electrons the chief contribution to the mass operator M is made by diagram systems with the largest number of closed loops. The average distance between particles r_s is a relatively small parameter in this case. The calculations involve an unperturbed Green's function, the Coulomb potential and the so-called modified potential. The equation for the Green's function is always nonlinear but it may be treated as a quasisingle particle problem. An approximation was used, taking into account the correlation between particles which results in shielding of the charges. No information is obtained on the plasma oscillations, such as their frequency and extinction because the potentials were time-averaged. Application of the quasisingle-particle approximation may be extended to the $1.8 \leq r_s \leq 5.5$ range. (TTT)

20037 RECIPROCITY RELATIONS IN A COMPRESSIBLE PLASMA. Chen, H. C.; Cheng, D. K. (Syracuse Univ., N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas Propagation, AP-13: 989-90(Nov. 1965).

Derivations of the reciprocity theorem for electromagnetic fields, a useful relation in electromagnetic theory, are discussed. Present interest in the radiation and propagation phenomena in plasma environments caused a consideration of media which are compressible. Compressible media are characterized by the existence of a pressure field which is dependent both on time and space variables. Maxwell's equations must be modified, and the hydrodynamic equation of electron motion and the combined equation of continuity and state must be considered. It does not appear that the question of whether or not the usual reciprocity theorem will apply to compressible media can be answered in an intuitive manner. The present treatment

examines the validity of the reciprocity theorem in a compressible plasma. This analysis shows that the validity of the reciprocity relation in a compressible plasma implies the validity of the usual reciprocity statements relative to impedances, gain, and effective areas in an isotropic medium. In antenna work, the reciprocity theorem assures that the radiation pattern of a magnetic current source in a compressible plasma is the same as the response pattern when the source configuration is used for receiving. (BBB)

20038 NONLINEAR SECOND HARMONIC GENERATION IN AN INHOMOGENEOUS PLASMA. Sodha, Mahendra Singh; Kaw, Predhiman Krishan (Indian Inst. of Tech., New Delhi). J. Phys. Soc. Jap., 21: 134-42(Jan. 1966).

An investigation was made of the nonlinear generation of the second harmonic component in the current density in an inhomogeneous plasma due to a sinusoidal electric field, a density gradient and a temperature gradient. The appropriate Boltzmann's transfer equation for electrons was solved to obtain an expression for the second harmonic component of current density which was then used in studying the nonlinear growth of the second harmonic of an electromagnetic wave in an inhomogeneous plasma and also the magnitude of the second harmonic component in the reflected wave from an inhomogeneous plasma-free space interface. (auth)

20039 MICROWAVE SCATTERING BY TURBULENT PLASMA IN A MAGNETIC FIELD. Kubo, Uichi; Inuishi, Yoshio (Osaka Univ.). J. Phys. Soc. Jap., 21: 184(Jan. 1966).

Measurements are reported of microwave scattering in helium discharge tubes, both for quiescent and turbulent plasma states, which show that the enhanced microwave attenuation was due to scattering by the turbulent plasma. (L.B.S.)

20040 HARMONIC GENERATION IN A SHORT MAGNETIZED PLASMA COLUMN. Yatsui, Kiyoshi; Inuishi, Yoshio (Osaka Univ.). J. Phys. Soc. Jap., 21: 195-6 (Jan. 1966).

Observations are reported on the generation of higher harmonics from helical oscillations in an argon positive column (0.3 torr) near the critical magnetic field for helical instability. The harmonic generation is ascribed to the appearance of the turbulence in the magnetized plasma column. (L.B.S.)

20041 DISCUSSION ON THE PLASMA EDGE PHENOMENA IN THE UNIFIED TREATMENT FOR THE PROBE IN A COLLISIONLESS PLASMA. Dote, Toshihiko (Inst. of Physical and Chemical Research, Tokyo); Itatani, Ryohei. J. Phys. Soc. Jap., 21: 203-4(Jan. 1966).

The assumption that the asymptotic behavior of the potential follows the so-called quasi-neutral solution of the Poisson equation for the plasma region far from the probe is deduced theoretically, and the characteristics near the plasma edge are discussed. (L.B.S.)

20042 AN INTERFEROMETER DESIGNED FOR THE DETECTION OF SMALL SHIFTS IN WAVELENGTH OF SPECTRAL LINES EMITTED BY PLASMAS, AND FOR MEASURING THE RATIO OF SUCH SHIFTS TO THE LINE WIDTH. Burgess, D. D.; Cooper, J. (Imperial Coll. of Science and Tech., London). J. Sci. Instrum., 42: 829-33(Dec. 1965).

An instrument is described that makes possible the accurate measurement of the ratio of small changes in wavelength of a spectral line to the line width. Measurement of this ratio is the basis of a new method of measuring electron temperatures in plasmas. The instrument is based on a Fizeau fringe interferometer. Photoelectric detection is used, and, because the instrument has no scanning parts, a time resolution of 10^{-6} sec or better is easily obtained. The conditions for the use of the instrument and the corrections for instrumental effects are discussed. (auth)

20043 SCATTERING OF RUBY LASER LIGHT BY A DENSE PLASMA. Consoli, T.; Gormezano, C.; Slama, L. (CEN, Saclay, France). Phys. Lett., 20: 267-8(Feb. 15, 1966). (In French).

The measurement of the electron density and temperature of a "θ pinch" produced plasma during the afterglow by means of 90° scattering of ruby laser light is described. (auth)

20044 OBSERVATION OF SOUND WAVES IN AFTERGLOW PLASMAS BY MEANS OF TONKS-DATTNER RESONANCES. Nygaard, K. J. (Sperry Rand Research Center, Sudbury, Mass.). Contract No. AF19(628)-4183. Phys. Lett., 20: 370-2(Mar. 1, 1966).

The electric breakdown of a gas by a high voltage pulse will excite various sound waves. The propagation of an axial shock wave and a radial standing sound wave in afterglow plasmas was studied by means of Tonks-Dattner resonances. (auth)

20045 MEASUREMENTS ON A LASER-PRODUCED PLASMA. Fabre, E.; Vasseur, P.; Bevernage, G. Phys. Lett., 20: 381-2(Mar. 1, 1966). (In French).

Measurements of electron density in a plasma produced by a laser were made by probes and microwaves. The plasma expansion in a uniform magnetic field was observed by high speed photography. (auth)

20046 INFLUENCE OF IMPURITIES ON THE ELECTRON TEMPERATURE IN A THETA PINCH. Andelfinger, A.; Chodura, R.; Decker, G.; Duechs, D.; Fuenfer, E.; Heiss, A.; Hermansdorfer, H.; Keilhacker, M.; Ulrich, M.; Zwicker, H. (Institut fuer Plasmaphysik, Munich). Phys. Lett., 20: 491-3(Mar. 15, 1966).

Experiments were carried out with the megajoule theta pinch Isar I at Garching to examine the influence of impurities (mainly O_2) on the electron temperature T_e in a deuterium plasma. (auth)

20047 FORBIDDEN CONTINUUM: FREE-BOUND TRANSITIONS IN HYDROGEN PLASMAS. Weinberg, Michael; Berry, R. Stephen (Univ. of Chicago). Phys. Rev., 144: 75-81(Apr. 8, 1966).

It is shown that local electric fields in ionized gases can lead to forbidden free-bound transitions. The photodetachment of electrons from H^- is considered, and specifically the cross section for detachment into continuum s waves is calculated from a binary-collision model. The corresponding forbidden radiative attachment is computed. The calculations indicate that in hydrogen plasmas with ion densities of 10^{15} cm^{-3} or above, the forbidden continuum should make a large contribution to the near-infrared emission. The effect may also appear in alkali plasmas. (auth)

20048 GENERAL CHARACTERIZATION OF A TWO-FLUID ANISOTROPIC WARM PLASMA IN PRINCIPAL COORDINATES. Chen, Hollis H. C.; Cheng, David K. (Syracuse Univ., N. Y.). Phys. Rev., 144: 177-81(Apr. 8, 1966).

A macroscopic characterization of a two-fluid compressible plasma in an external constant magnetic field is suggested by the introduction of two "compressivity tensors," one for the electrons and one for the ions, as new constitutive parameters. A new set of four governing equations is formulated which are mathematically concise and are amenable to meaningful physical interpretation. Because the compressivity tensors and the permittivity tensor are Hermitian and pairwise commutative, a unitary transformation is found which simultaneously diagonalizes the matrix forms of all three parameter tensors. This permits a change of basis for the governing equations to a principal coordinate system. The longitudinal components of the electromagnetic fields can then be decoupled from their transverse components. (auth)

20049 FLUCTUATION SPECTRUM OF A PLASMA ADDITIVE IN A TURBULENT GAS. Granatstein, V. L. (Bell Telephone Labs., Murray Hill, N. J.); Buchsbaum, S. J.; Bugnolo, D. S. Phys. Rev. Lett., 16: 504-7(Mar. 21, 1966).

The spectrum of plasma fluctuations in turbulent weakly ionized argon was studied. It was found that the spectrum can be explained by statistical turbulence theory based on the Heisenberg mixing model. (D.C.W.)

20050 ON THE STATISTICAL MECHANICS OF A RELATIVISTIC QUANTUM PLASMA. Balescu, R. (Univ. Libre, Brussels). Physica, 31: 1599-1602(Nov. 1965).

The first results of a study of a relativistic electron-positron gas interacting with radiation, which should lead to the rigorous derivation of the laws of macroscopic electrodynamics, the hydrodynamics of a gas of Dirac particles, etc., are given. Also the framework of the theory is presented. A system corresponding to a set of N electrons is considered. This system is assumed to be imbedded in a neutralizing background of positive charge. The electromagnetic field produced by the charges is described by a set of transverse oscillators and by the electrostatic Coulomb interactions. (J.F.P.)

20051 CHERENKOV RADIATION IN A WARM PLASMA UNDER THE ACTION OF AN INFINITE MAGNETOSTATIC FIELD. McKenzie, J. F. (Royal Armament Research and Development Establishment, Sevenoaks, Eng.). Proc. Phys. Soc. (London), 87: 349-60(Feb. 1966).

The radiation emitted by a charged particle moving with uniform speed parallel to an infinite magnetic field in a hot plasma is evaluated when the phase speed of the excited waves is very much greater than the thermal speed. It is found that Cherenkov radiation in the extraordinary mode cannot be excited by particles travelling with speeds less than the geometric mean of the thermal speed and the speed of light in vacuum. The total energy emitted in the form of plasma waves exceeds that excited in the extraordinary wave when the particle moves slower than $\sqrt{2}$ times the minimum speed capable of exciting the extraordinary wave radiation. (auth)

20052 GENERATION AND AMPLIFICATION OF MICROWAVES IN PLASMA. Kowalski, Miroslaw. Przegl. Elektron., 6: 417-30(Sept. 1965). (In Polish).

A brief review of the frequency dependent electrical transmission characteristics of plasmas is given, followed by a discussion of a number of plasma amplifiers and microwave generators and their characteristics for both mercury and cesium plasmas. A few plasma cathodes are discussed. The difficulties of utilizing plasmas for microwave amplification and generation include requirements of a very highly ionized gas and a very high current density for a given amplification factor, the requirement of a very large volume (long length) of plasma for lower frequencies, and inadequate means, at the present state of the art, of coupling millimeter wavelengths to the plasma. Furthermore, to achieve a high degree of stability for plasmas with 10^{14}-10^{15} electrons/cm^3, the degree of ionization of the gas should be about 50%. This last difficulty may be overcome with a Penning cesium arc. (TTT)

20053 PLASMA POTENTIAL MEASUREMENTS BY ELECTRON EMISSIVE PROBES. Kemp, Robert F.; Sellen, J. M. Jr. (Thompson Ramo Wooldridge Inc., Redondo Beach, Calif.). Rev. Sci. Instrum., 37: 455-61(Apr. 1966).

Several methods of using hot wire, electron emissive probes for potential measurements in quiescent plasmas are described. A plot of the probe emission characteristic gives a precise d-c determination; the floating probe rapidly follows potential fluctuations of several volts magnitude; the cutoff slope detects small signals up to tens of megacycles per second. Calculations are discussed that describe the potential distributions around an emissive wire immersed in plasma, with and without the formation of a virtual cathode. Sheath dimensions are ~10 wire diameters at 10^{10} ions/cm^3; orders of magnitude larger at 10^6 ions/cm^3. Emission levels appropriate to given plasma densities are shown. The range of application has a low density limit of ~10^4 ions/cm^3 because of minimum useful emitted current, and a high density limit of ~10^{12} ions/cm^3 because of electron collection from the plasma. (auth)

20054 TIME RESOLVED MICROWAVE INTERFEROMETRY AS DIAGNOSTIC TOOL FOR DECAYING PLASMA AFTERGLOWS. Estin, A. J.; Anderson, M. M. (National Bureau of Standards, Boulder, Colo.). Rev. Sci. Instrum., 37: 468-70(Apr. 1966).

Two methods for obtaining time resolved electron density measurements with a microwave interferometer are described. Precision phase measurement techniques permit these methods to be used in weak afterglow plasmas with a high resolution such that decaying afterglow can be followed down to $\omega_p/\omega \sim 0.01$ with a time resolution of 10 μsec. (auth)

20055 ACCURATE METHOD FOR MEASURING SMALL FREQUENCY SHIFTS IN PLASMA LOADED CAVITIES. Huggins, R. W. (Univ. of Illinois, Urbana). Rev. Sci. Instrum., 37: 527-8(Apr. 1966).

A method of measuring frequency shifts of an X-band cavity with an accuracy of 10 kc is described, which gives an electron density of about three orders of magnitude below the plasma frequency. A block diagram of the apparatus is shown, and a brief description is given of a steady-state experiment system. (L.B.S.)

20056 ON THE NONLINEAR THEORY OF A PLASMA BEAM WITH PERIODIC STRUCTURE. Repalov, N. S. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 11: 12-19(Jan. 1966). (In Ukrainian).

The nonlinear effects of the interaction of a plasma beam with periodic structure formed by alternating dielectric disks having different dielectric permeabilities are studied. The magnitude of the amplitude of longitudinal fluctuations in velocity in a saturation regime and the time of establishment of the steady-state regime are found. An expression is derived for the current density, and the possibility of using resonance effects in such a medium for compensation of the defocussing effect of the space charge forces is discussed. (auth)

20057 GENERAL 13-MOMENT APPROXIMATION FOR THE FOKKER-PLANCK EQUATION OF A PLASMA. Hertweck, Friedrich (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch., 20a: 1243-55(Oct. 1965). (In German).

For the Fokker-Planck-equation for a plasma the system of moment equations is derived. The highest order moments considered are the components of the heat flux. For these the condition must be satisfied that they are small compared with $(\frac{5}{2})p\sqrt{p/\rho_e}$. All moments of lower order, especially the difference velocity of electrons and ions (i.e. the electrical current) and the anisotropy of pressure are arbitrary in this approximation. (auth)

20058 MOMENT EQUATION OF A PLASMA AND THE ONSAGER RELATIONS. Hertweck, Friedrich (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch., 20a: 1256-8(Oct. 1965). (In German).

It is shown that the transport coefficients, following from the linearized 13-moment approximation, satisfy the Onsager relations. A short discussion of the transport coefficients is added. (auth)

20059 APPLICATION OF THE 13-MOMENT APPROXIMATION TO THE PROBLEM OF THE RUN-AWAY ELECTRON. Hertweck, Friedrich (Institut fuer Plasmaphysik GmbH, Garching, Ger.). Z. Naturforsch., 20a: 1259-61 (Oct. 1965). (In German).

The non-linear 13-moment approximation is applied to the problem of run-away-electrons. The solution is compared with the results obtained by Dreicer. (auth)

20060 TIME AND SPACE-RESOLVED ELECTRON DENSITIES IN A THETA PINCH AT VARIOUS DISTANCES ALONG THE DISCHARGE AXIS. Eberhagen, A.; Glaser, H. (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch., 20a: 1268-73(Oct. 1965).

The influence of the finite length of the discharge coil on the axial behavior of a theta pinch plasma column is investigated by measuring electron density profiles at various distances from the midplane of the coil along the dis-

charge axis. The resulting line densities were then checked by an independent method. For a parallel trapped magnetic field it was possible in this way to measure end losses and also the collection rate of the contraction wave in the case of an antiparallel trapped magnetic field. (auth)

20061 TIME-RESOLVED PROFILE MEASUREMENTS OF IMPURITY LINES IN A THETA PINCH DISCHARGE. Eberhagen, A.; Bernstein, M. J.; Hermansdoefer, H. (Institut fuer Plasmaphysik, Munich). Z. Naturforsch., 20a: 1375-85(Nov. 1965).

Line profile measurements were carried out on a small theta pinch experiment in order to get information on the ion motions during the discharge. A Fabry-Perot interferometer combined with a so-called Fafnir arrangement was used for measuring the shape of the investigated N V (4603 Å) and O VI (3811 Å) lines. The additional use of a polarizer and $\lambda/4$ plate made it possible to eliminate Zeeman splitting caused by a magnetic field present, which affects the line shape, and to measure the magnitude of the magnetic field strength at the site of line emission in the plasma. By means of a combined system comprising image converter and intensifier, the emission regions of the investigated lines in the plasma could be identified. The experimentally obtained results are discussed considering the different influences leading to line broadening in the present experiment. (auth)

20062 EXCITATION OF OSCILLATIONS IN OPPOSING STREAMS OF NONUNIFORM PLASMA. Baikov, I. S.; Rukhadze, A. A. (Lebedev Physics Inst., Moscow). Zh. Tekh. Fiz., 35: 1913-24(1965). (In Russian).

The stability of two identical nonuniform streams of plasma moving in opposite directions parallel to a strong external magnetic field is discussed, the velocities, temperatures, and densities of the streams being assumed to vary in a direction perpendicular to the motion. The calculations for nonuniform streams were undertaken in an effort to account for the poor agreement with experiment of the analogous theory previously developed for uniform streams. The treatment is based on the kinetic equation without collision terms, from which dispersion equations are derived in the geometric optics approximation. It is shown that the nonuniformity of the streams strongly affects their stability only at frequencies below at least one of the relevant Larmor frequencies. Separate dispersion equations are derived and discussed for frequencies below the ion Larmor frequency and between the ion and electron Larmor frequencies. Owing to the nonuniformity there are instabilities at these frequencies that are not damped by the external magnetic field; expressions are derived for the corresponding logarithmic increments. Instabilities of this type should occur in a closed magnetic trap. At frequencies from 10^5 to 10^8 cycle/sec, it is suggested that the resulting oscillations may give rise to anomalous diffusion of the plasma transverse to the magnetic field and thus account for the short life of the plasma in this installation. (ATD)

20063 ON THE THEORY OF A CHARGED PARTICLE BEAM TRAVERSING A PLASMA. Tsytovich, V. N.; Shapiro, V. D. Zh. Tekh. Fiz., 35: 1925-32(1965). (In Russian).

An analytic solution is obtained in the quasi-linear approximation for the spectral energy density of the oscillations excited in a semi-infinite plasma by a charged particle beam having a narrow velocity distribution incident normally on the plasma surface with a velocity exceeding the phase velocity of the plasma waves. Some results previously obtained from qualitative considerations (Ya. B. Feynberg and V. D. Shapiro, ZhETF, 47: 1389(1964)) are confirmed; in particular, the energy of the excited plasma oscillations is confined largely to a thin layer near the surface, the thickness of which decreases exponentially with time. The case of an incident pulse of charged particles of finite duration is also treated, and expressions are derived for the pulse shape and the energy density of the plasma oscillations after the particles have penetrated deeply into the plasma. (ATD)

20064 ON THE THEORY OF THE STABILITY OF A SPATIALLY NONUNIFORM CURRENT IN A PLASMA. I. LOW-FREQUENCY WAVES. Mikhailovskii, A. B. Zh. Tekh. Fiz., 35: 1933-44(1965). (In Russian).

The stability of a plasma carrying a spatially nonuniform electron current in a strong uniform longitudinal magnetic field is discussed. A dispersion equation for irrotational waves with frequencies small compared with the ion cyclotron frequency is derived in a quasiclassical approximation under the assumptions that collisions and the thermal motions of the ions can be neglected. It is found that if the inhomogeneity is sufficiently pronounced the plasma is unstable, owing to the coupling, due to the inhomogeneity, between the transverse drift of the plasma and the longitudinal current. It is shown that the current-convective instability and the present instability (which is accordingly called the "collision free current-convective instability"), are different limiting cases of a single more general type of instability in an inhomogeneous plasma carrying a current. There is an analogy between collision free current-convective instability and flute instability, stemming from the fact that (different) charge transport mechanisms are operative in both cases. The logarithmic increment of the current-convective instability can considerably exceed that of the flute instability even when the velocity of the relative motion giving rise to the current is comparatively low, of the order of the ion thermal velocity. An approximate upper bound is derived for the frequency of the oscillations resulting from the current-convective instability. The effect of including the thermal motions of the electrons and ions is discussed briefly. It is shown that shearing of the lines of force of the external magnetic field (as in the case of a helical field) together with a finite Larmor radius of the ions tends completely to suppress the current-convective instability. (ATD)

20065 ON THE THEORY OF THE STABILITY OF A SPATIALLY NONUNIFORM CURRENT IN A PLASMA. II. WAVES WITH FREQUENCIES HIGHER THAN THE ION CYCLOTRON FREQUENCY. Mikhailovskii, A. B. Zh. Tekh. Fiz., 35: 1945-59(1965). (In Russian).

A previous discussion (A. B. Mikhaylovskiy, Zh. Tekh. Fiz., 35: 1933(1965)) of the stability of a plasma carrying a spatially nonuniform electron current in a strong uniform longitudinal magnetic field is extended to include the excitation of oscillations with frequencies higher than the ion cyclotron frequency. It is shown that such oscillations can be excited only when the velocity of the beam electrons with respect to the plasma exceeds the phase velocity of the waves. The dispersion equation is derived for the case of an electron beam with a rectangular velocity distribution and the conditions for instability are obtained. The mechanism underlying the instability is discussed in some detail. The instability involves transport of the charge of the electron beam by drift in the external magnetic field and the transverse component of the electric field of the perturbation; the instability is accordingly analogous to the low-frequency collision free current-convective instability. The case of an axially symmetric monoenergetic beam whose density is proportional to $1 - (r/a)^2$ is solved (here r is the distance from the axis and a is a constant). If the cold plasma is also inhomogeneous (with the same radial dependence of the density) and is sufficiently dense, the system is no longer unstable. The boundary conditions at plane electrodes are introduced and the discrete spectrum of standing waves and their stability are discussed. Relaxing the requirement that the beam be monoenergetic alters the results only slightly, for the instability under discussion is much more sensitive to the spatial distribution of the beam than to its velocity distribution. In the final section are discussed kinetic effects due to resonance particles with velocities close to the phase velocity of the waves. (ATD)

20066 ON THE THEORY OF THE STABILITY OF AN ION BEAM INJECTED TRANSVERSELY TO A MAGNETIC FIELD INTO A PLASMA. Mikhailovskii, A. B.; Pashitskii, E. A. Zh. Tekh. Fiz., 35: 1960-71(1965). (In Russian).

A discussion is given on the stability of a nearly monoenergetic ion beam injected transversely to the magnetic field into a magnetic trap containing a plasma with a Maxwell distribution of electron and ion velocities, which is applicable to the case of a trap in which ions are continuously injected. The dispersion equation is derived for a monoenergetic beam and a uniform magnetic field, and the roots are derived and discussed for frequencies near harmonics of the ion Larmor frequency and for frequencies in the continuous spectrum far above the ion Larmor frequency but below the electron Larmor frequency. The effect of the longitudinal inhomogeneity of the magnetic field is discussed. When longitudinal ion velocities and cyclotron damping are taken into account, the longitudinal inhomogeneity of the magnetic field is found to increase the critical beam density above which instability occurs. The effect of a distribution of beam ion velocities (energy inhomogeneity) is also discussed, and it is shown that this, too, tends to stabilize the system. It is concluded that injection into a magnetic trap of a monoenergetic ion beam transversely to the magnetic field can excite oscillations over a wide range of frequency and wavelength, and these can give rise to large anomalous turbulent diffusion. Means for partially stabilizing some of these oscillations are discussed. (ATD)

20067 INFLUENCE OF ELECTRON HEATING ON THE ACOUSTIC INSTABILITY OF A PLASMA IN AN ELECTRIC FIELD. **Tsendin, L. D. (Kalinin Polytechnic Inst., Leningrad). Zh. Tekh. Fiz., 35: 1972-7(1965). (In Russian).**

The stability with respect to low-frequency longitudinal oscillations of a weakly ionized plasma in an external electric field is discussed in a quasi-hydrodynamic approximation in which effects of heat production and transport are included. The plasma is assumed to consist of atoms and singly charged ions of the same mass and temperature, and electrons. In order to avoid the instability discussed by A. V. Gurevich (ZhETF, 35: 392(1958)), it is assumed that the electron collision frequency does not decrease with increasing electron temperature $T_e^{-\frac{1}{2}}$. Simple gas kinetic estimates involving the collision frequencies are employed for the heat and electric conductivities, the viscosity, and the heat transfer constant between the electrons and the heavy particles. The roots of the dispersion equation for longitudinal oscillations are presented and discussed for the two limiting cases that the frequency is high or low, respectively, compared with uf, where f is the collision frequency between electrons and heavy particles (ions plus neutral atoms) and u is the average relative energy transfer per collision. The imaginary part of the frequency in the high-frequency case contains a term which differs in form from the Cherenkov term and is significant when the electron temperature is high. The stability of the high-frequency oscillations depends only on the electric field strength and the degree of ionization. The stability of the low-frequency oscillations, which correspond to ordinary sound distorted by the electric field, depends on the derivative d log uf/d log T_e. (ATD)

20068 GLOW DISCHARGE BETWEEN COAXIAL DIELECTRIC CYLINDERS IN A LONGITUDINAL ELECTRIC AND A RADIAL MAGNETIC FIELD. **Chekmarev, I. B. (Ioffe Physico-Technical Inst., Leningrad). Zh. Tekh. Fiz., 35: 1978-83(1965). (In Russian).**

The electron and ion density and velocity distributions in a glow discharge plasma within the annular space between two coaxial nonconducting cylindrical walls in the presence of a radial magnetic field are calculated in a hydrodynamic approximation. The collision frequency of electrons with neutrals is assumed to be much lower than the electron Larmor frequency, and the collision frequency of ions with neutrals is assumed to be much higher than the ion Larmor frequency. The plasma is assumed to be weakly ionized, and the pressure is assumed to be so low that volume recombination can be neglected and so high that the hydrodynamic approximation is valid. Collisions between ions and electrons are neglected, and every collision between an ion and a neutral particle is assumed to result in charge exchange. The calculations are performed by a perturbation technique based on the smallness of Hartman's number, the unperturbed distribution functions being assumed to be Maxwellian. As an example, the results are presented of a numerical calculation for a 10 A glow discharge in molecular hydrogen within a 33.1 cm radius tube at a pressure of 13.33 N/m^2 and a temperature of 1000°K. The charge exchange cross section for both electrons and ions with neutral particles was assumed to be 10^{-23} cm^2 and it was assumed that $du/dT_e = 0.6 \times 10^{-6}$ degree^{-1}, where u is the average fractional energy transfer in a collision between an electron and a neutral particle, and T_e is the electron temperature. Calculations were made for a radial magnetic field of 0.01 Wb/m^2 and for no magnetic field. The longitudinal electric field required to maintain the discharge was found to be 13.2 V/cm in the presence of the magnetic field and 8.8 V/cm with no magnetic field. The presence of the magnetic field caused a considerable increase in the electron density, owing to the decrease of the diffusion velocity, and shifted the position of maximum electron density slightly outward. The ion velocity distribution was highly anisotropic in the presence of the magnetic field, the transverse and longitudinal ion temperatures being 10^3 and 1.588×10^5°K, respectively. (ATD)

20069 INTERACTION BETWEEN HIGH FREQUENCY OSCILLATIONS IN A PLASMA AND IONIC SOUND. **Fedorchenko, V. D.; Muratov, V. I.; Rutkevich, B. N. Zh. Tekh. Fiz., 35: 2021-7(1965). (In Russian).**

The interaction in a plasma of ionic sound with modes having frequencies near the electron Larmor or electron Langmuir frequencies was investigated. The plasmas were produced at pressures of the order of 10^{-4} mm Hg in a 9 cm diameter 100 cm long metal tube in a 400 to 1000 Oe longitudinal magnetic field by oscillating discharge between an electron gun producing a 50 cm long 2 cm diameter hollow beam of 160 ev electrons and a collector held near the floating potential. The cathode current was 200–250 mamp. Under these conditions there were spontaneously produced low-frequency oscillations with frequencies of the order of 10 kHz. Investigations with the aid of a movable probe of the frequency and intensity distribution of these oscillations as functions of the magnetic field strength, length of the plasma column, and nature of the gas, and observation of longitudinal ejection of ions from the column, indicated that these oscillations were due to standing waves of ionic sound. The plasmas were excited at frequencies near the electron Larmor or the electron Langmuir frequencies with the aid of an antenna located at one end of the discharge tube. Standing waves were formed in both frequency regions. The electromagnetic oscillations excited at frequencies somewhat below the Larmor frequency were found to be slow extraordinary waves, having a phase velocity less than that of light. The plasma oscillations excited near the Langmuir frequency were also slow. When the intensity of the high-frequency oscillations was sufficiently increased, low- and high-frequency satellite lines appeared in their spectra at frequencies equal to the sum and difference of the excitation frequency and the frequency of ionic sound. The relative intensities of these satellites were different in different portions of the pass bands, and under some conditions one or the other satellite was very intense. When the low-frequency satellite was very intense, the intensity of the ionic sound increased when the high-frequency excitation was applied; when the high-frequency satellite was very intense, the intensity of the ionic sound decreased when the high-frequency excitation was applied. This is to be understood in terms of the interaction of elementary plasma excitations (plasmons), the satellites being formed by absorption or emission of a low-frequency (ionic sound) plasmon by a high-frequency plasmon. The randomization of phases with the consequent formation of wave packets necessary for the validity of the analysis in terms of plasmon interactions may result from interaction with different kinds of fluctuations. (ATD)

20070 INVESTIGATION OF THE DECAY OF HELIUM PLASMA IN A SPHERICAL CONTAINER. **Anisimov, A. I.; Budnikov, V. N.; Vinogradov, N. I. (Ioffe Physico-Technical Inst., Leningrad). Zh. Tekh. Fiz., 35: 2028-33(1965). (In Russian).**

An investigation was made of the decay of spectroscopically pure helium plasmas at pressures from 0.02 to 0.2 mm Hg and electron concentrations from 10^{11} to 10^{13} cm^{-3} in a 14 cm diameter spherical glass container, which had been previously outgassed at 3×10^{-9} mm Hg and which was maintained at a temperature between 300 and 500°K during the measurements. The investigation was undertaken to determine the magnitude and mechanism of volume recombination. The logarithm of the charged-particle density decreased with time less rapidly than linearly, the nonlinearity being most pronounced at the higher pressures. From this it is concluded that volume recombination contributes significantly to the plasma decay. The volume recombination and ambipolar diffusion effects were separated by analyzing the slope of the decay curve as a function of pressure, electron concentration, and wall temperature in terms of an approximate theory of diffusion and recombination in a spherical plasma. The ratio of the intensity of the recombination radiation to the rate of recombination was found to be independent of the experimental conditions. From this it is concluded that only a single recombination mechanism is significant at the pressures, temperatures, and charged particle concentrations investigated, and from the dependence of recombination rate on electron concentration it is concluded that the effective mechanism is three-body collision between an ion and two electrons. (ATD)

20071 ELECTROMAGNETIC RADIATION FROM AN ELECTRON BEAM TRAVERSING A PLASMA IN A MAGNETIC FIELD. Golant, V. E.; Zhilinskii, A. P.; Liventseva, I. F.; Sakharov, I. E. (Kalinin Polytechnic Inst., Leningrad). Zh. Tekh. Fiz., 35: 2034-41(1965). (In Russian).

An investigation was made of the microwave (3 cm wavelength) fields in and radiation from plasmas which were produced by 20 to 900 mamp beams of 0.8 to 2 kev electrons traversing helium at pressures from 5×10^{-3} to 1×10^{-1} mm Hg in the presence of a 2 kOe or weaker uniform longitudinal magnetic field. The radial distribution of the longitudinal microwave electric field was determined with the aid of a uhf probe and the radiated microwaves were received with an open ended waveguide section located close to the discharge tube. The uhf signals were recorded with a superheterodyne receiver. One conductor of the uhf probe was employed also as a Langmuir probe to determine the plasma density. The microwave field strength and radiation intensity were investigated as functions of the magnetic field strength, gas pressure, beam current, and electron energy, and the results are presented graphically and discussed. The intensity of the uhf radiation varied greatly with the conditions of operation, but such radiation was observed at magnetic field strengths an order of magnitude lower than that corresponding to the electron cyclotron resonance, and in some cases in the absence of a magnetic field. Further work is required to elucidate the nature of the coupling between the longitudinal plasma oscillations and the transverse electromagnetic waves which make the radiation possible. (ATD)

20072 USE OF OPEN CYLINDRICAL RESONATORS IN PLASMA RESEARCH. Anisimov, A. I.; Budnikov, V. N.; Vinogradov, N. I.; Golant, V. E. (Ioffe Physico-Technical Inst., Leningrad). Zh. Tekh. Fiz., 35: 2042-51 (1965). (In Russian).

Advantages are pointed out of the use of open-ended circular cylindrical resonators rather than closed resonators for measuring electron concentrations in plasmas by the resonance frequency shift method; formulas are presented (most of these are taken directly from the literature) for calculating resonance frequencies, field distributions, and Q-factors of open resonators; and experiments are described which prove the feasibility of using open resonators in plasma diagnostics. A 2.3 cm diameter 20 cm long open copper resonator excited in the 3 cm and 8 mm wavelength regions was employed to measure electron concentrations between 3×10^{9} and 10^{11} cm^{-3} in helium plasmas excited in a 1.6 cm diameter 50 cm long quartz tube containing helium at 0.2 mm Hg by 20 μsec discharges. Measurements were made using the E_{011}, E_{012}, and E_{221} modes of the open resonator and the E_{010} mode of the closed resonator, and were found to be in good agreement with each other. The logarithm of the electron concentration decreased linearly with time, and the scatter of the experimental points from the straight line did not exceed 10%. It is concluded that an open cylindrical resonator can be employed to measure electron concentrations in plasmas. (L.B.S.)

20073 ON THE THEORY OF A SPHERICAL PROBE AT MEDIUM AND HIGH PRESSURE. Kagan, Yu. M.; Perel', V. I. (Leningrad State Univ.). Zh. Tekh. Fiz., 35: 2069-75(1965). (In Russian).

The electron current to a spherical probe at a negative potential is calculated directly from the kinetic equation by methods previously employed to calculate the electron current to a spherical probe held at the space potential. The result reduces to the usual formula when the pressure is low, but the kinetic treatment is necessary at high pressures because the diffusion equations are invalid, owing to the low-energy transfer in collisions between electrons and atoms. To facilitate the approximate solution of the kinetic equation, the distribution function is expressed as the sum of two terms representing electrons moving in different directions. This procedure is shown to give the correct result in the limiting case of low pressures and to provide a very good approximation in the limiting case of high pressures; it is assumed, therefore, that the procedure will give a good approximation also at intermediate pressures. It is found that the electron current to the probe increases less rapidly than exponentially as the probe potential approaches the space potential and that the deviation from exponential rise is the greater, the higher the pressure. The usual method of determining the electron temperature from the slope of the upper part of the logarithmic probe characteristic, therefore, overestimates the temperature. The expression derived for the probe current can be evaluated only when the velocity dependence of the electron mean free path is known. Probe characteristics were calculated with the assumption that the electron mean free path is proportional to v^s (v is the electron velocity) for four different values of the constant s between 1 and −2, and the characteristics are presented graphically. When the electron temperature is determined from the derivative of the probe characteristic in the manner proposed by Yu. M. Kagan, V. I. Perel', and P. O. Pipatti (Vestnik LGU, No. 8, 129(1955)), the relative error is $(s + 2)\,kT_e/2$ ev at high pressures, where k is Boltzmann's constant, T_e is the electron temperature, e is the electron charge, and V is the probe potential. At lower pressures the error is smaller. (ATD)

20074 ON THE DECELERATION OF IONS IN AN ARC DISCHARGE IN A MAGNETIC FIELD. Glasko, V. B.; Sveshnikov, A. G.; Semashko, N. N.; Timofeev, A. V. (Moscow State Univ.). Zh. Tekh. Fiz., 35: 2083-91(1965). (In Russian).

The rate of deceleration of high-energy ions owing to their passage through, and interaction with, an arc discharge plasma in a longitudinal magnetic field is calculated. The calculations were undertaken because of the practical use of an arc discharge to accelerate the dissociation of molecular ion beams employed for injecting plasma into adiabatic plasma-confining systems. The interaction of a high-energy ion with the arc plasma is described by an equivalent viscosity, and the rate of energy loss is calculated for an ion whose Larmor orbit intersects the arc column. With the aid of this result and the one-dimensional Fokker-Planck equation, the energy distribution of the ions is calculated both for the steady state that is established during the injection pulse and for the nonsteady state between pulses. A numerical solution for ion energies between 15 and 62.5 kev is presented graphically. For the conditions in the "Ogra" installation, the relaxation time for deceleration of the ions by their interaction with the arc plasma is 0.3 msec, and it is concluded that the density of high-energy ions is determined mainly by this interaction and not by loss of high-energy

ions due to charge exchange collisions with neutral atoms. (ATD)

20075 PROPAGATION OF SURFACE WAVES IN A MAGNETOACTIVE PLASMA. **Stepanov, K. N. Zh. Tekh. Fiz., 35: 1349-58(Aug. 1965). (In Russian).**

The propagation of an extraordinary electromagnetic wave perpendicular to an applied magnetic field along the diffuse boundary between a plasma and a vacuum is discussed. The plasma density is assumed to fall smoothly to zero within a distance small compared with the wavelength. The dispersion equations are derived and discussed for the cases of the infinite plane boundary of a semi-infinite plasma in a uniform magnetic field, an infinite plane plasma layer of small thickness in a uniform magnetic field, and a cylindrical plasma in an azimuthal magnetic field. It is found that the finite thickness of the transition region does not greatly affect the propagation of surface waves with frequencies lower than the electron Larmor frequency. When the wave frequency exceeds the Larmor frequency, the wave resonates with the Langmuir frequency at some point within the transition layer, and the wave amplitude becomes large; the effects of spatial dispersion are significant if the collision frequency is low. The dielectric tensor in the presence of spatial dispersion is used to calculate the wave amplitude in the resonance region. (TCO)

20076 INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS ON THE ELECTRON TEMPERATURE IN A MAGNETOGASDYNAMIC CHANNEL. **Shakhnov, I. I.; Chekmarev, I. B. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 35: 1359-63(Aug. 1965). (In Russian).**

The variations of electron temperature during one-dimensional flow of a weakly ionized plasma in crossed electric and magnetic fields are calculated. The plasma consists of two components with widely differing ionization potentials and has flow velocity transverse to the magnetic field. The electric field is perpendicular to the magnetic field but not necessarily to the flow velocity. The hydrodynamic equations for the electron gas with electron diffusion and source terms are simplified by neglecting electron inertia and viscosity. The electron source function is fixed by assuming equilibrium between the electrons and the atoms and ions of the easily ionized plasma component. The final electron temperature in the flowing plasma and the behavior of an initially isothermal plasma during transition to the asymptotic state are calculated. The flow in crossed fields is found to increase considerably the electron temperature above the ion temperature. Numerical results for an Ar–K mixture are presented. (TCO)

20077 INSTABILITY OF A ROTATING PLASMA FILAMENT IN THE PRESENCE OF HIGH-FREQUENCY RADIAL PULSATIONS. **Vandakurov, Yu. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 35: 1364-71(Aug. 1965). (In Russian).**

The stability with respect to radial pulsations of a perfectly conducting rotating plasma filament in a strong longitudinal magnetic field, on which is superimposed a longitudinal high-frequency oscillating magnetic field, is investigated. The rotation frequency of the plasma is assumed small compared with the ion Larmor frequency and the frequencies of the oscillating magnetic field and the radial pulsations. The magnetohydrodynamic equations are linearized for perturbations proportional to exp (im φ), where φ is the azimuthal coordinate, and approximate solutions are derived. The cases of a constant-density plasma filament and of a filament with density proportional to exp ($-ar^2$), where r is the distance from the axis, are treated. It is found that the previously derived stability criteria are applicable to the filament with constant density, but that a filament with a Gaussian density distribution can become unstable, whether it rotates or not, at frequencies equal to or greater than the ion Larmor frequency, even in the absence of all known unstabilizing factors. (TCO)

20078 MECHANISM OF PLASMA FORMATION DURING DEVELOPMENT OF BEAM INSTABILITY. **Kornilov, E. A.; Kovpik, O. F.; Fainberg, Ya. B.; Kharchenko, I. F. Zh. Tekh. Fiz., 35: 1372-7(Aug. 1965). (In Russian).**

The production of plasma by a 10- to 50-mamp, 2- to 5-kev electron beam traversing a glass tube containing air, Ar, or H at different pressures in the presence of a 0- to 2-kOe longitudinal magnetic field was investigated. The plasma density was determined with Langmuir probes, with an interferometer, and by the detuning of a resonant cavity. Oscillations excited in the plasma were received with a dipole antenna and studied using a spectral analyzer and resonance wavemeters. At pressures below a critical value, the plasma density was close to the beam density, and oscillations near the Larmor frequency were observed. When the pressure was increased through the critical value, the plasma density increased by two or three orders of magnitude, and oscillations were observed near the Langmuir frequency. In the region of instability, which is ascribed to the Cherenkov effect, the electron beam lost nearly all its energy to the plasma. The results together with previous results indicate that highly ionized hot plasmas can be obtained with a beam of higher power. (TCO)

20079 TIME VARIATIONS OF HIGH FREQUENCY OSCILLATIONS DURING DEVELOPMENT OF INSTABILITY IN A BEAM-PLASMA SYSTEM. **Kornilov, E. A.; Kovpik, O. F.; Fainberg, Ya. B.; Bolotin, L. I.; Kharchenko, I. F. Zh. Tekh. Fiz., 35: 1378-84(Aug. 1965). (In Russian).**

Continued studies on the production of a plasma by an electron beam transversing a gas in a longitudinal magnetic field are described. It was found that oscillations are excited at integral multiples of half the Larmor frequency and that the width and peak frequency of the spectrum of these oscillations vary periodically at the frequency of ion-acoustic oscillations. The spectrum narrows with increasing pressure and broadens with increasing beam current. When the magnetic field strength is increased beyond a certain value, the oscillations cease to be continuous and come in bursts which follow one another at intervals that decrease with increasing magnetic field. Tilting the beam with respect to the magnetic-field direction increases the amplitude of the oscillations by two orders of magnitude. (TCO)

20080 COMPENSATING DISTORTIONS OF A HELICAL MAGNETIC FIELD. **Karmanov, F. V.; Mel'nikov, V. K. Zh. Tekh. Fiz., 35: 1385-9(Aug. 1965). (In Russian).**

An experimental test of a previously proposed theory on the compensation of the distortions in a helical magnetic field was performed. A triple helical field and a double helical perturbing field were produced in a cylindrical chamber, and a plane compensating field normal to the chamber axis and a 400-Oe uniform magnetic field parallel to the chamber axis were provided. Electrons were injected by a rotating hot cathode and caught at the other end of the chamber by a fluorescent screen. The electron patterns on the screen were photographed for different strengths of the magnetic fields and are found in agreement with the predictions of the theory. (TCO)

20081 INTERACTION OF POLARIZED PLASMA STREAMS IN A MAGNETIC FIELD THAT INCREASES TOWARD THE PERIPHERY. **Zykov, V. G.; Stepanenko, I. A.; Tolok, V. T. Zh. Tekh. Fiz., 35: 1390-3(Aug. 1965). (In Russian).**

Experiments are reported on the interaction of oppositely directed plasma streams in a biconical cusped magnetic field. The cusp field was produced in a stainless steel chamber by capacitor discharges through appropriate windings. The maximum field strength in the mirror region was 8800 Oe, and in the cusp at the chamber wall, 2250 Oe. Plasmas were injected from one, two, or four conical guns, fired by capacitor discharges. The behavior of the plasmas was observed by photographing their luminescence, and the plasma polarization was measured by a double floating probe. The plasma polarization disappeared only after the

plasma penetrated several centimeters into the region of oppositely directed field. The oppositely directed plasmas interacted strongly without observable turbulence, but some of the plasma escaped through the cusp and the mirrors. (TCO)

20082 INSTABILITY OF A PLASMA DISCHARGE WITH OSCILLATING ELECTRONS. I. MICROWAVE RADIATION. Pavlichenko, O. S.; Dushin, L. A.; Kuznetsov, Yu. K.; Adamov, I. Yu. (Physico-Technical Inst., Kharkov). Zh. Tekh. Fiz., 35: 1394-1400(Aug. 1965). (In Russian).

The microwave radiation at 8800 Mc from a high-voltage PIG reflex discharge plasma was studied in H and He in a uniform magnetic field up to 2500 Oe. Microwave emission was observed at integral and half-integral harmonics of the electron cyclotron frequency, and also very strongly at a frequency $\omega \approx \omega_0$. The plasma density and electron and ion temperatures were measured for different conditions of pressure, discharge current, and magnetic field. The magnetic-field dependence of the microwave-noise temperature in the three distinct magnetic-field regions is described, and effects of pressure and discharge current on the noise-temperature variation are discussed. (M.J.T.)

20083 INSTABILITY OF A PLASMA DISCHARGE WITH OSCILLATING ELECTRONS. II. ANOMALOUS DIFFUSION OF PLASMA. Pavlichenko, O. S.; Dushin, L. A.; Kuznetsov, Yu. K.; Nikol'skii, I. K.; Adamov, I. Yu. Zh. Tekh. Fiz., 35: 1401-4(Aug. 1965). (In Russian).

The stability and anomalous diffusion of a high-voltage PIG reflex discharge plasma were investigated. The charged-particle flux to the chamber wall first decreased with increasing magnetic field and then began to increase with increasing field, at a critical field strength. When the magnetic field increased through the critical value, the plasma density decreased abruptly, the microwave noise suddenly increased, and oscillations of the plasma column were observed, using a rotating mirror. The variation of the critical field strength with gas pressure in H_2 and He plasmas is described. No anomaly in the electron temperature at the critical field was observed. The magnetic field strength at onset of anomalous diffusion is found to be an order of magnitude less than predicted by the theory of F. Hoh. It is suggested that a turbulent state with a broad spectrum of low-frequency oscillations may arise from the interaction between the plasma and the oscillating electron beam. (TCO)

20084 MOTION OF PLASMA BURSTS IN A UNIFORM AXIALLY SYMMETRIC MAGNETIC FIELDS. Azovskii, Yu. S.; Guzhovskii, I. T.; Mazalov, Yu. P.; Pistryak, V. M. Zh. Tekh. Fiz., 35: 1405-7(Aug. 1965). (In Russian).

The motion of plasma bursts, having charged-particle densities of $2 \times 10^{13}/cm^{-3}$ and velocities near 6×10^6 cm/sec, in the uniform part of an axially symmetric magnetic field was studied. The pressure within the plasmas was measured with a compensated magnetic probe, and the diameters of sections of the plasmas were measured with a pulsed scintillator plasmascope. The variations of the probe signal duration, the charged-particle density, and the plasma temperature with plasma position are shown for different values of the magnetic-field strength. As the plasma moved down the field, its length increased, its radius remained unchanged, and its temperature and charged-particle density decreased. (TCO)

20085 STRIATIONS IN A HOLLOW CATHODE PLASMA. Moskalev, B. I. Zh. Tekh. Fiz., 35: 1408-10(Aug. 1965). (In Russian).

Discharge plasmas of H, pure Ne, and a Ne–He–Ar mixture in hollow cathodes were studied at various pressures. At relatively high pressures, the brightness of the plasma within the cathode varied smoothly from one end to the other, and the axial voltage gradient was small. At lower pressures, striations appeared in the plasma, increasing in number with decreasing pressure. Probe measurements showed that at the leading edge of each striation the potential changed discontinuously by an amount equal to the ionization potential of the gas. Rapid sputtering of the cathode material occurred opposite the bright regions of the plasma, and the sputtered metal was deposited on the inner cathode surface opposite the least bright regions. (TCO)

20086 INVESTIGATION OF THE ELECTRIC DOUBLE LAYER IN A PLASMA. Bakulin, E. A.; Stlepin, E. V.; Shcherbinina, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 35: 1419-22(Aug. 1965). (In Russian).

The thickness of the double layer at the boundary of a cylindrical electrode in a low-voltage mercury-vapor discharge plasma was determined by measuring its capacitive reactance. The plasma concentration and temperature were measured using a cylindrical probe. The capacitance of the cylindrical electrode, measured by a resonance method, is presented as a function of electrode potential for discharge currents of 2, 3, and 4 mamp. Under the assumption that the measured capacitance is due almost entirely to the double layer, the layer thickness was calculated with the formula for the capacitance of a cylindrical capacitor with unit dielectric constant. The double layer thicknesses were also calculated using the $\frac{3}{2}$ power law. (TCO)

20087 INFLUENCE OF A MAGNETIC FIELD ON THE PARAMETERS OF A HIGH-FREQUENCY DISCHARGE. Vagner, S. D.; Krylov, N. A. Zh. Tekh. Fiz., 35: 1423-7(Aug. 1965). (In Russian).

A study was made of the dependence of the electron temperature, mean ionization frequency per electron, and radial electric potential in Ar and Ne h-f discharge plasmas on the strength of an external longitudinal magnetic field from 0 to 500 Oe. The discharges were excited in Mo glass tubes by external ring electrodes; the tubes contained two cylindrical probes on the axis and two plane probes on the wall. The investigated parameters decreased with increasing magnetic field for low fields and increased with increasing field for fields above a critical value. The critical magnetic field strength increased with increasing gas pressure. The measured ionization frequencies were compared with those calculated from the electron temperatures. The presence of anomalous losses of charged particles in the plasma above the critical magnetic field strength was shown. (M.J.T.)

20088 MEASUREMENT OF THE CONDUCTIVITY OF A GAS DISCHARGE PLASMA BY A RADIOFREQUENCY METHOD. Akimov, A. V.; Konenko, O. R. (All-Union Electrotechnical Inst., Moscow). Zh. Tekh. Fiz., 35: 1451-3(Aug. 1965). (In Russian).

A plasma diagnostic technique in which the plasma conductivity is determined by observing the resonant frequency shift of a tank circuit when the plasma is introduced into the helical winding providing the inductance was tested. The positive column of a Hg–Ar gas discharge tube was investigated using resonant frequencies of 7 to 80 Mc. The apparatus was calibrated by introducing electrolytes of known conductivity into the tank coil. The plasma conductivity was monitored by measuring the potential distribution along the positive column with probes. It was found that introducing either the plasma or the electrolyte could either increase or decrease the resonant frequency. Decrease of the resonant frequency is attributed to a capacity effect. The plasma conductivities measured at higher frequencies were much lower than the true conductivities, due to the skin effect. By measuring the conductivity with different resonant frequencies, i.e., with different skin depths, data on the radial distribution of conductivity can be obtained. (TCO)

20089 GENERATION AND INVESTIGATION OF SHOCK WAVES AND SUPERSONIC PLASMA STREAMS IN A DISCHARGE SHOCK TUBE. Grechikhin, L. I.; Min'ko, L. Ya. (Inst. of Physics, Minsk, BSSR). Zh. Tekh. Fiz., 35: 1454-60(Aug. 1965). (In Russian).

An experimental investigation was made of the propagation of electrodynamically excited shock waves and plasma streams in a discharge shock tube. Conical, cylindrical,

and coaxial discharge tubes were used. The merits of each as a plasma acceleration mechanism are discussed. Certain relations between the electrodynamically excited shock waves and plasma streams are discussed. The results indicate that the plasma stream consists of smaller, individual streams; such a structure enhances the possibility of accurate measurement of propagation velocity, which in the experiment was determined within a 10% error. The wave structure of plasma currents and the nature of variations of wave structure as a function of the initial pressure in the tube were also investigated. (ATD)

20090 IMPEDANCE OF A DIODE FILLED WITH A RAREFIED PLASMA. Basksht, F. G. Zh. Tekh. Fiz., 35: 1471-82(Aug. 1965). (In Russian).

The effect of finite time of flight of the electrons on the impedance of a diode filled with rarefied plasma is considered. The interelectrode distance is assumed small in comparison with the mean free path of the particles, but large in comparison with the Debye radius. The distribution functions of the electrons and ions are Maxwellian functions for particles whose velocities are directed from the cathode to the anode and zero for oppositely directed velocity. The frequency dependence of the impedance with resonant maximum corresponding to the frequency of the electron Langmuir resonance is obtained. (tr-auth)

20091 PLASMA KINETIC EQUATION FOR THE DARWIN HAMILTONIAN. Krizan, John E. (Univ. of Vermont, Burlington). 6p. (CONF-651051-2). ORAU. Gmelin, AED-CONF-65-280-2.

From American Physical Society, New England Section, Fall Meeting, Orono, Me.

A kinetic equation is derived using the Darwin Hamiltonian. (D.C.W.)

Shielding

Refer also to abstract 19486.

20092 (AE-220) MEASURED AND PREDICTED NEUTRON FLUX DISTRIBUTIONS IN A MATERIAL SURROUNDING A CYLINDRICAL DUCT. Nilsson, J.; Sandlin, R. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Mar. 1966. 38p. Dep. mn.

The radial fast neutron flux attenuations in the material (iron) surrounding ducts of diameters 7, 9, and 15 cm and total duct length of about 1.5 m were investigated with and without neutron scattering cans filled with D_2O in the duct. Experimentally the problem was solved by the use of foil activation techniques. Theoretically it was attacked by, in the first place, a Monte Carlo program specially written for this purpose and utilizing an importance sampling technique. In the second place non- and single-scattering removal flux codes were tried, and also simple hand calculations. The Monte Carlo results accounted well for the fast flux attenuation, while the non- and single-scattering methods overestimated the attenuation generally by a factor of 10 or less. Simple hand calculations using three empirical parameters could be fitted to the measured data within a factor of 1.2–1.3 at penetration depths greater than 3–4 cm. The distribution of the D_2O-scattered flux could well be described in terms of single scattering. (auth)

20093 (N-65-22849) EFFECT OF SHIELD SPLITTING AND PLACEMENT IN NUCLEAR-PROPELLED SPACE VEHICLES. Final Report. Aronson, Raphael; Klahr, Carl N.; Steinberg, Herbert; Held, Kalman (TRG, Inc., Syossett, N. Y.). Mar. 1, 1961. Contract NASw-132. 138p. (NASA-CR-62456; TRG-136-FR). CFSTI $4.00 cy, $1.00 mn.

The effect of splitting and placement of various idealized shadow shield configurations appropriate to manned nuclear rockets was investigated. The effect on neutron dose in both hydrogenous and nonhydrogenous shield situations was considered, as well as the effect on gamma dose. The results indicate that in some circumstances proper placement or multiple splitting of the shield can affect the dose by a factor of three or more, over and above any r^2 effect due to differences in the relative sizes of reactor and payload. (STAR)

20094 (NP-15926) DOSE-ATTENUATION VARIATION WITH INCIDENT GAMMA-RAY ENERGY IN TWO-LEGGED CONCRETE AND STEEL DUCTS. Chapman, J. M. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Apr. 1966. 30p. (R-442). CFSTI $2.00 cy, $0.50 mn.

Gamma-ray dose-attenuation factors were measured in concrete and steel ducts. For concrete, 3-foot-square and 11-inch-square ducts were used with ^{198}Au (0.412 Mev), ^{137}Cs (0.662 Mev), and ^{60}Co (1.25 Mev) gamma sources. For steel, an 11-inch-square duct was used with ^{137}Cs and ^{60}Co sources. Attenuation factors for given geometries were compared as a function of incident gamma-ray energy. The relative effectiveness of steel and concrete ducts of a given geometry was determined. It was found that the attenuation factor decreases monotonically with increasing energy in concrete ducts. However, in the 11-inch steel duct the attenuation factor for the high-energy source (^{60}Co) was greater than for the low-energy source (^{137}Cs). In comparing the 11-inch concrete and 11-inch steel ducts, it was found that dose rates in the concrete duct were higher by a factor of about 2. Measured attenuation factors were compared with values obtained using a computer code based on the albedo concept. It was found that calculated attenuation factors agree to within ±30% of the measured attenuation factors. (auth)

20095 (ORNL-3805) OGRE—A MONTE CARLO SYSTEM FOR GAMMA-RAY TRANSPORT STUDIES, INCLUDING AN EXAMPLE (OGRE-P1) FOR TRANSMISSION THROUGH LAMINATED SLABS. Penny, S. K.; Trubey, D. K.; Emmett, M. B. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A system of computer subroutines (called OGRE) was designed for the study of gamma-ray transport by the Monte Carlo method. The various steps of the procedure were isolated so that a complete code to solve a specific problem may be easily synthesized. A cross section system which is easy to use is included. A specific example of the system's use (OGRE-P1) which computes the dose rates from gamma rays penetrating laminated slabs is included. (auth)

20096 (ORNL-3844) INSTRUCTIONS FOR THE OPERATION OF CODES ASSOCIATED WITH THE LOW-ENERGY INTRANUCLEAR CASCADE CALCULATION. Bertini, Hugo W.; Francis, Hemma E.; Guthrie, Miriam P. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 136p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Instructions are given for processing a tape containing all the programs associated with a low-energy intranuclear cascade calculation. The calculation is valid for incident nucleon energies from about 50 to 350 Mev and for incident charged pion energies from about 50 to 250 Mev. The codes involved are the cascade code, two analysis codes which construct various histograms using the data generated by the cascade, an evaporation code which performs evaporation calculations on the nuclei that are left at the completion of the cascade calculation, an angular momentum code, and a code which allows the cascade calculations to be made with different nucleon density distributions within the nucleus. A detailed description of all the binary outputs is given, and a list of running times is included. (auth)

20097 (ORNL-RSIC-10) A SURVEY OF EMPIRICAL FUNCTIONS USED TO FIT GAMMA-RAY BUILDUP FACTORS. Trubey, D. K. (Oak Ridge National Lab., Tenn.). Feb. 1966. Contract W-7405-eng-26. 113p. Dep. ORNL Free.

The use of simple functions to estimate gamma buildup factors is reviewed on the basis of simplicity and accuracy. Analysis shows that the best fitting form is the 4 term polynomial fit with coefficients published by Capo. For most purposes, however, a function proposed by Berger is

recommended since it is as simple to use as the linear form and is essentially as good as the more complicated forms. Tables of the coefficients are given for the linear, quadratic, Berger, and Taylor fitting functions. Some typical graphs of the functions are also given. Use of the Berger and polynomial functions is demonstrated for the case of exponential source distributions in plane geometry and the use of buildup factors in finite geometry is briefly described. (auth)

20098 (ORNL-RSIC-12(Vol.1)) ABSTRACTS OF THE LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER (SPACE AND ACCELERATOR SHIELDING). (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 46p. ORNL Free.

The 99 included abstracts cover all the space and accelerator shielding documents that are in the literature store of the RSIC. (M.O.W.)

20099 (ORNL-RSIC-14) THE EXPONENTIAL TRANSFORM AS AN IMPORTANCE-SAMPLING DEVICE. A REVIEW. Clark, Francis H. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 53p. Dep. ORNL Free.

The exponential transform is reviewed, with emphasis on its use as a guide to effective importance sampling in the solution of the Boltzmann equation by Monte Carlo methods. Contributions of various workers are assembled, along with numerical results. Special consideration is given to approximate forms and to effective practical methods. Problems related to negative effective cross sections, tracking across discontinuities, directional biasing in inhomogeneous media, and high variance in back-scattered components are specifically treated. (auth)

20100 (ORNL-TM-1423) CALCULATED FLUXES OF LESS THAN 50-Mev NEUTRONS DIFFUSING BENEATH THE SHIELD OF A MESON PRODUCTION FACILITY. Kinney, W. E. (Oak Ridge National Lab., Tenn.). Feb. 23, 1966. Contract W-7405-eng-26. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Fluxes of neutrons of energy less than 50 Mev which diffuse beneath an idealized shield for a meson production facility were estimated by Monte Carlo methods. Neutrons from a 400-Mev point isotropic source impinged on the shield configuration, where lower energy neutrons were produced by intranuclear cascades. Neutrons below 50 Mev were then treated, and the fluxes computed by statistical estimation. The fluxes at 0, 5, and 10 ft behind the shield were calculated to be $(2.7 \pm 0.7) \times 10^{-10}$, $(3.6 \pm 1.1) \times 10^{-11}$, and $(1.4 \pm 0.4) \times 10^{-11}$ neutrons cm^{-2} (source neutron)$^{-1}$, respectively. The flux at 0 ft produces an average whole-body dose rate of 3.6 r/hr. (auth)

20101 A GENERAL THEORY OF FIRST-PASSAGE DISTRIBUTIONS IN TRANSPORT AND MULTIPLICATIVE PROCESSES. Moyal, J. E. (Argonne National Lab., Ill.). J. Math. Phys., 7: 464-73(Mar. 1966).

The "Milne problem," expressed in probabilistic terms, is solved for general transport and multiplicative processes. If a particle initially in a given state at a given position inside a surface τ is multiply scattered while traveling through a fixed medium, then given the scattering cross sections and, if required, the probability distribution for a change of state between collisions (e.g., by diffusion or ionization), the problem is to obtain the probability that the particle eventually effects a first passage through a specified position on the surface τ and in a specified state. In the case of a multiplicative process, the problem is, given in addition the rates of creation and annihilation of particles (considering the nature of the particles as a state variable), to obtain the probability that eventually n particles will emerge for the first time through specified positions on τ and in specified states (with n = 0,1,2, ...). A general solution is given in the form of a convergent series whose terms are obtained by iteration; this solution is unique if and only if the probability θ_∞ of an infinity of atomic events before a first passage (which is the limit of a certain nonincreasing sequence) is identically zero; in the multiplicative case $\theta_\infty \neq 0$ may be taken to mean that the process is "supercritical." The mathematical theory which leads to this solution is a generalization of the corresponding theory for time-dependent Markov processes in which the time variable is replaced by a set of surfaces ordered by inclusion of their "insides" and is valid for Euclidean space of any number of dimensions. Applying it to the 4-dimensional space of special relativity with ordered sets of spacelike surfaces, one obtains a Lorentz-invariant formulation of the theory of physical Markov processes. A few examples are given. (auth)

20102 APPLICATION OF INVARIANT IMBEDDING TO THE REFLECTION AND TRANSMISSION PROBLEM OF GAMMA RAYS. I. Shimizu, Akinao; Mizuta, Hiroshi (Nippon Atomic Industry Group Co., Japan). J. Nucl. Sci. Technol., 3: 57-66(Feb. 1966).

Equations were derived for the reflection and transmission functions of γ rays through slabs of finite thickness, making use of the invariant imbedding principle. Numerical solutions were obtained for the reflection function (albedo) of semi-infinite medium. The results agreed well with the solutions by Monte Carlo method. Comparisons were also made with experimental results. Fair agreement was obtained except for the angular distribution of the reflected photons from light elements. (auth)

20103 METHODS OF CALCULATION IN NEUTRON SHIELDING. Nachtigall, D. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 8: 82-5(Feb. 1966). (In German).

Methods for calculation of neutron shielding are described with consideration of inelastic scattering, elastic scattering, and neutron capture. The microscopic behavior of neutrons is discussed. Examples are given of the calculation methods. (J.S.R.)

Solid State Physics

See *also* CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstracts 19460, 19499, and 20335.

20104 (BNL-944) PASSAGE OF CHARGED PARTICLES THROUGH CRYSTAL LATTICES. Brookhaven Lecture Series Number 46. Erginsoy, Cavid (Brookhaven National Lab., Upton, N. Y.). Apr. 21, 1965. Contract AT(30-2)-Gen-16. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A series of experimental results are reviewed that show the influence of the crystalline structure of solids on the various phenomena accompanying the passage of charged particles through them. (M.O.W.)

20105 (COO-587-19) MAGNETIC PROPERTIES OF INSULATORS. Quarterly Report, August 15, 1965–November 15, 1965. Noble, Gordon A. (IIT Research Inst., Chicago, Ill.). Dec. 5, 1965. Contract AT(11-1)-587. 49p. (IITRI-U6028-19). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The width, shape and relative areas of optical absorption bands associated with color centers show some changes as the concentration rises from 10^{16} to 10^{17} cm^{-3}. Reflection spectra can provide optical data at concentrations from 10^{16} to 10^{19} cm^{-3}. Measurements were made of the normal specular reflection using a modification of the spectrophotometer used for absorption. The difference between the reflection coefficients of the colored and uncolored crystals shows color center reflection bands. Irradiation of KCl with gamma rays at room temperature produces reflection bands in the F and V regions. Additive coloration produces F, M, N, L type bands. The reflection bands are generally less well resolved than the absorption bands. At higher

concentrations some sharp peaks are observable in the R, M, N spectral region. At very low concentrations in samples showing only F bands, the ratio of the real to the imaginary part of the index of refraction is several thousand. The experimental results are qualitatively consistent with a simple model. (auth)

20106 (COO-1044-23) F AGGREGATE CENTERS IN SODIUM FLUORIDE [Thesis]. Special Report No. 6. Konrad, Karl (Illinois Inst. of Tech., Chicago). Jan. 1966. Contract AT(11-1)-1044. 57p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Extensive, low temperature x irradiation of monocrystalline NaF resulted in the formation of high color center densities. Warming from the temperature of x irradiation (either 80 or 200°K) caused thermal bleaching of the large F' band which peaks at ca 470 mμ. Thermally induced formation of M centers was observed. The extent of aggregation was not great, and letting the crystal equilibrate in the dark at room temperature did not further enhance the concentration of F aggregate centers as it does in other alkali halides. Optical F band bleaching resulted in the formation of large concentrations of F aggregate centers, typically, $OD_{M_1} > OD_F$. Color centers in x irradiated, natural (Villiaumite) and synthetic NaF were studied via diffuse reflectance spectra. X irradiation of Villiaumite resulted in color center absorptions at wavelength positions expected for NaF. X irradiation of synthetic NaF resulted in prominent F and M_1 bands (F at 345 mμ and M_1 at 505 mμ). Optical F band bleaching caused the appearance of a peak at 305 mμ, which was also observed when x irradiated monocrystalline NaF was bleached with F band light. R_2 band bleaching caused a decrease in the R_2 band and increased in the F and M_1 bands. The results support the van Doorn and Haven F_3 model of the R center. (auth)

20107 (EUR-2734.e) HYDROGEN MOTION IN PRIMARY SOLUTIONS OF HYDROGEN IN SOME TRANSITION ELEMENTS. Kley, W.; Peretti, J.; Rubin, R.; Verdan, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 1966. 52p. (CONF-650932-11). Dep. mn.

From Symposium on the Inelastic Scattering of Neutrons by Condensed Systems, Upton, N. Y.

The scattering of cold neutrons was measured from VH_x, NbH_x and PdH_x systems at low hydrogen concentrations. The difference of the normalized intensities of the hydrogen system and the pure host lattice, reveals the neutron scattering distribution of the hydrogen probe in the host lattice. Those intensity distributions show the expected high energy local modes of the hydrogen impurity well above the maximum frequency of the host lattice. For VH_x and NbH_x in the α phase, also a low energy neutron distribution of a few Mev is observed, close to the energy of the impinging neutrons. A part of a certain distortion near the maximum host lattice frequency, in addition, the host lattice frequency distribution can be seen through the hydrogen band modes. For Nb, two pronounced peaks are found at energy transfers of 25.9 and 18.3 Mev. They agree reasonably well with recent calculations of the frequency distribution of Nb. (auth)

20108 (LA-3471) DYNAMICS OF DISORDERED HARMONIC LATTICES IN ONE, TWO, AND THREE DIMENSIONS. Payton III, Daniel N.; Visscher, William M. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Jan. 27, 1966. Contract W-7405-eng-36. 22p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Extensive numerical and analytic studies of vibrational spectra and normal modes of harmonic systems with varying degrees of substitutional disorder were made. The effects on frequencies and eigenvectors of random mixtures of two or more species of atoms with differing masses and differing couplings to nearest and next-nearest neighbors were investigated. Using the IBM-7030 digital computer, spectra for linear chains of 100,000 atoms were obtained. In order to keep machine running times less than 10 minutes, calculations in two and three dimensions were limited to arrays of approximately 1000 atoms. Particular emphasis is placed upon the properties of the vibrational spectra and localized modes of the two dimensional lattices. Varying composition, mass ratio, and order affect the spectra in two and three dimensions in ways analogous to those affected in the linear chain. Mention is made of possible means of verification of some qualitative features of the results. (auth)

20109 (MIT-3031-3) LOW-TEMPERATURE STUDIES BY NEUTRON DIFFRACTION. Progress Report, February 1, 1965-January 31, 1966. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics). Feb. 15, 1966. Contract AT(30-1)-3031. 6p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Further developments for each of the following three research activities are briefly discussed; electronic and nuclear polarization in superconducting V_3Si, magnetization measurements on V_3Si, and nuclear polarization in hexagonal cobalt. (M.O.W.)

20110 (NASA-TN-D-3379) EFFECT OF IONIZING RADIATION ON RUBY. Forestieri, Americo F.; Grimes, Hubert H. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr. 1966. 9p. CFSTI $0.15 cy, $0.50 mn.

The ability of ruby to operate as a laser is dependent on the presence of chromium^{3+} (Cr^{3+}) impurity ions. Since radiation can cause severe ionization effects in ionic solids, it is desirable to determine whether ruby would be affected by such a radiation field. High-purity ruby and α-aluminum oxide (α-Al_2O_3) were studied by optical absorption and electron paramagnetic resonance techniques both before and after irradiation with high-energy x rays. Irradiation of ruby crystals that had been preannealed in air resulted in a 20% loss of Cr^{3+}, the formation of Cr^{4+} and Cr^{6+} ions, and an unidentified V-type defect center. The effects found indicate complex interactions which depend strongly on the crystal pretreatment, purity, and irradiation dose. Probable ionization processes are given to account for the results observed. (auth)

20111 (NYO-2471-12) INTERNAL FRICTION AND ELECTRON MICROSCOPY STUDIES IN ALUMINUM [Thesis]. Report No. 424. Mayadas, Ashok Frank (Cornell Univ., Ithaca, N. Y. Materials Science Center). Feb. 1966. Contract AT(30-1)-2471. 122p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Internal friction measurements at 4 kc were made on aluminum single crystals, with four different orientations and deformed 0.05 to 7% by axial compression or tension or bending at room temperature as well as at 77°K. The change of the Bordoni peaks was studied as a function of orientation, amount, kind, and temperature of deformation and amplitude of vibration. Simultaneously the dislocation structures in these samples were studied by transmission electron microscopy and correlated with the internal friction data. Long straight dislocations having ⟨110⟩ Burgers vectors and lying along the ⟨110⟩ directions, a structure characteristic of first stage hardening, are associated with low, broad not fully developed peaks. Entangled dislocations and the presence of hardening mechanisms in the lattice are related to the commonly encountered Bordoni peaks. The peaks are amplitude independent even when the driving amplitude is in the breakaway region. For small deformation the lower temperature Bordoni peak appears prominently only when the sample is deformed at 77°K in which case it appears to be a single relaxation peak, and the higher temperature peak is almost completely suppressed. These observations are not fully explained by any of the current theories of the Bordoni relaxation, although the Paré modification of the Seeger-Donth theory appears the most promising. (auth)

20112 (NYO-2581-1) FUNDAMENTAL STUDIES IN HIGH-TEMPERATURE MATERIALS PHENOMENA. Annual Progress Report. (Pennsylvania State Univ., University Park. Materials Research Lab.). Feb. 1966. Contract AT(30-1)-2581. 67p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Summaries are presented of research progress in the areas of the elastic anharmonic properties of perfect crystals, the properties of crystals containing high concentrations of point defects, and the initial onset of ordering in disordered systems. These topics were investigated through measurements of the dielectric, elastic, magnetic, and spectroscopic properties of ceramic materials. (W.L.G.)

20113 (NYO-3001-1) A STUDY OF THE INTERACTION BETWEEN POINT DEFECTS AND DISLOCATIONS THROUGH DISLOCATION DAMPING EXPERIMENTS. Annual Progress Report. (Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.). Feb. 1, 1966. Contract AT(30-1)-3001. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Progress in studies on statistical thermodynamics of defect interactions, dislocation damping in dilute copper alloys, diffusion-controlled dislocation damping, thermally activated dislocation motion, dislocation damping in Type II superconductors (Nb), and dislocation pinning by ultraviolet light is reported. (W.L.G.)

20114 (ORNL-3935) SOLID STATE DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1965. (Oak Ridge National Lab., Tenn.). Apr. 1966. Contract W-7405-eng-26. 82p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Brief summaries of 78 investigations being carried out at ORNL in the field of solid state physics are presented. (M.O.W.)

20115 (ORNL-TM-1422) PROPERTIES OF V_K CENTERS IN POTASSIUM IODIDE [Thesis]. Keller, Frederick Jacob (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 170p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Submitted to Tennessee Univ., Knoxville.

Two properties of the V_K center in potassium iodide were studied and are reported. The V_K center is considered to be a hole trapped in a region of the perfect crystal (i.e., a self-trapped hole). The luminescence which is the result of an electron recombining with the hole and the thermal motion of the hole were investigated. Optical techniques were used in the investigation of both of these properties of the V_K center. Both emission and absorption experiments were performed. (M.O.W.)

20116 NUCLEAR MAGNETIC RELAXATION OF THE MANY-SPIN SYSTEM. Fenzke, D. (Karl-Marx Univ., Leipzig). Ann. Phys. (7), 16: 281-8(1965). (In German).

The semiclassical relaxation theory of Redfield and its expansion by Pfeifer were used for the calculation of the longitudinal magnetization in the first and second approximation of molecules with N equal nuclei (spin ½) whose correlation times of the motion in comparison with the Larmor frequency are random but small with respect to the relaxation times (molecules in liquid and absorbed states). If the relaxation depends exclusively on the intramolecular dipole-dipole interaction between the N spins and the thermal motion was described by the classical rotation scattering of the molecule, in which all initial states are of equal value, relaxation rates are obtained, in the first approximation which are given by simple decomposition in uncorrelated moving two-spin systems and weighted mean. The second approximation gives information on the deviation on the relaxation function from an exponential function. (tr-auth)

20117 EFFECT OF ULTRAVIOLET RADIATION ON A SINGLE CRYSTAL OF POTASSIUM CHLORATE IRRADIATED WITH X RAYS. Fayet, Jean-Claude; Thieblemont, Bernard (Faculte des Sciences, Orsay, France). Compt. Rend., Ser. B, 262: 60-2(Jan. 3, 1966). (In French).

The ultraviolet irradiation of a potassium chlorate monocrystal previously irradiated with x rays causes the disappearance of two paramagnetic centers. A new center appears whose magnetic and optical characteristics are comparable to those of a V_K center. (tr-auth)

20118 QUADRUPOLE RESONANCE STUDY OF $NaClO_3$ IRRADIATED WITH X AND γ RAYS AT 78 DEG K. Dimitropoulos, Constantin; Salvi, Antoine; Dautreppe, Daniel (Centre d'Etudes Nucleaires, Grenoble, France). Compt. Rend., Ser. B, 262: 289-91(Jan. 24, 1966). (In French).

The decrease of the quadrupole resonance line of ^{35}Cl in $NaClO_3$ was observed during γ irradiation at 78°K and at room temperature. The restoration of the line was studied after γ and x irradiation at 78°K. A single restoration stage situated between −50 and −20°C was observed. (tr-auth)

20119 FLUORESCENCE PROPERTIES OF EUROPIUM IN POLYCRYSTALLINE MATRICES OF YTTRIUM ORTHOVANADATE. Loriers, Jean; Denis, Jean-Pierre; Briffaut, Jean-Pierre (CNRS, Bellevue, France). Compt. Rend., Ser. B, 262: 496-9(Feb. 14, 1966). (In French).

The role of different factors on the ultraviolet fluorescence of europium-activated yttrium vanadates ($Eu_xY_{1-x}VO_4$) was studied. The samples were prepared by dry methods, and their luminescence maximum is reached for relative europium concentrations of about 4%. The fluorescence is very sensitive to the wave length of the incident light, and the most efficient exciting radiations are between 3200 and 3400 Å. This region corresponds to the absorption maximum of the ion V^{5+}, so that it is shown that interionic energy transfer processes intervene in the fluorescence mechanism of Eu^{3+}. (tr-auth)

20120 APPROXIMATE SOLUTION OF HILL'S EQUATION. Payne, Herbert (Wright-Patterson Air Force Base, Ohio). J. Math. Phys., 7: 474-8(Mar. 1966).

A modified WKB approximation, amenable to successive corrections, to the solution of the linear differential equation of second order having a periodic coefficient in normal form is presented. Considered as an application of the related equation method, it uses the free-particle wave equation rather than, as in an alternative approach, Mathieu's equation. Particular attention is given the instances, where two simple turning points appear in the period and where there are no turning points. With respect to the one-dimensional crystal, it is shown how the energy band structure can be gleaned directly from the given periodic potential. (auth)

20121 ION BEAMS AND SOLID-STATE PHYSICS. McCaldin, J. O. (North American Aviation Science Center, Thousand Oaks, Calif.). Nucl. Instrum. Methods, 38: 153-64(1965).

Recent mutual interest between solid state and energetic ion physics is discussed. This interest has been stimulated largely by the discovery of channeling and blocking effects for energetic particles in crystalline targets. The following specific applications of such effects to the solid state are considered: 1. An analogy between interstitial diffusion and the channeling of low energy ions. 2. The radiation-enhancement of solid state diffusion, particularly of interstitials. 3. The use of blocking and channeling effects to determine the locations of trace impurities in a crystal. Also of current interest are the properties of crystals into which an ion beam has been driven. Under suitable experimental conditions, such ion-injected crystals retain the desirable properties of nearly perfect crystals. Unlike conventional materials, however, these ion-injected materials may be heavily supersaturated with a desired dopant; furthermore, experience with p-n junctions made by ion injection suggests that high chemical purity can be retained in such materials. (auth)

20122 DOPING OF SEMICONDUCTORS BY ION BOMBARDMENT. Gibbons, J. F. (Stanford Univ., Calif.); Moll, J. L.; Meyer, N. I. Nucl. Instrum. Methods, 38: 165-8(1965).

An investigation of the effects of bombarding various semiconductors (Si, GaAs, CdS, and ZnS) with ions of the rare earth elements thulium and neodymium was carried out. Preliminary measurements of the electrical and optical properties of the resulting bombarded layers are described. (auth)

20123 DOPING OF SILICON BY ION IMPLANTATION. Manchester, K. E. (Sprague Electric Co., North Adams, Mass.); Sibley, C. B.; Alton, G. Nucl. Instrum. Methods, 38: 169-74(1965).

The feasibility of doping silicon by directly implanting impurity atoms was demonstrated. Both phosphorus and boron ions were successfully implanted in silicon to produce electrical junctions. Junctions as deep as 1.2 μm were produced by phosphorus ions having energies the order of 80 kev. An electromagnetic separator was used to controllably produce uniform, large area implantations for evaluation experimentation. Correlations between junction depths and ion energies were obtained. Orientation effects were observed and it was found that the ⟨110⟩ direction is the easy direction for implanting. Monitoring of thermal treatments of implanted substrates by sheet resistance measurement indicates a very mild thermal anneal and removes most of the damage done during the implantation. These indications are further substantiated by reverse current measurements of junctions produced by implantation. Electrical characteristics of implanted junctions will be compared with those of diffused junctions. (auth)

20124 IMPLANTATION AND CHANNELING EFFECTS OF ALKALI ION BEAMS IN SEMICONDUCTORS. Medved, D. B.; Perel, J.; Daley, H. L.; Rolik, G. P. (Electro-Optical Systems, Inc., Pasadena, Calif.). Nucl. Instrum. Methods, 38: 175-7(1965).

Ion beams of K^+ and Cs^+ in an energy range from 1–20 kev were used in a study of penetration, channeling and type conversion in targets of oriented single crystal semiconductors, particularly silicon. The alkalis form n-type impurities in silicon. Targets of p-type silicon over a wide resistivity range were used to study type conversion and junction formation effects. Target resistivity, crystallographic orientation, energy and target temperature are important parameters in determining the profile of the implanted species and the junction depth, X_J. The effects of crystallographic orientation on junction depths (determined directly by angle/section and stain techniques) are strongly suggestive of a channeling process. The order of penetrability is ⟨110⟩ > ⟨111⟩ ≥ ⟨100⟩ and the sheet resistance of the implanted layers is consistently smaller for the transparent directions. The variation of junction depth with the energy of the ion is not as important as its dependence on the target temperature or crystallographic orientation (with the velocity of the ion rather than its energy being the determinant factor for measured values of X_J). The magnitude of the channeling effect is strongly temperature dependent. Concentrations of electrically active species in targets implanted by potassium are an order of magnitude higher than those achieved with cesium implantation under similar conditions. The profile of the electrically active species appears to have two parts; there is a layer of high concentration and relatively steep gradient followed by a persistent straggling tail. (auth)

20125 EXPERIENCE IN FABRICATING SEMICONDUCTOR DEVICES USING ION IMPLANTATION TECHNIQUES. King, W. J.; Burrill, J. T.; Harrison, S.; Martin, F.; Kellett, C. (Ion Physics Corp., Burlington, Mass.). Nucl. Instrum. Methods, 38: 178-9(1965).

The described process of ion "implantation" is defined as one in which the distribution of the arrested ions is determined by the target material and the species, energy, integrated flux and relative orientation of the incident ions. Energies utilized in this technique are sufficiently high (greater than 50 kev) to minimize sputtering and to produce useful junction depths without invoking the process of "channeling" along preferred crystal planes. The resulting process is highly controlled and can be used to fabricate semiconductor devices by implanting through a passivating surface oxide. Spectroscopically pure ^{11}B and ^{31}P ion beams are routinely accelerated to energies between 50 kev and 400 kev to produce p- and n-type layers in silicon, respectively. The following p-n junction devices have been successfully fabricated during the past 4½ years: a. Solar cells: consistent state-of-the-art cells with efficiencies greater than 13% under tungsten (2800°K) illumination and 10% under solar (air mass zero) illumination. b. Radiation detectors: passivated single counters (1.27 cm dia.) and spectrometer arrays with depletion depths of 1 mm (breakdown voltages >700 v), dead layers less than 0.1 μm and best room temperature resolutions of 60 kev. c. Unipolar field effect transistors: transconductance greater than 2000 μmho. d. Bipolar transitors: $\beta > 40$. Preliminary results on extension of the technique to wideband-gap materials are discussed. (auth)

20126 ON THE APPLICATION OF DIFFUSION THEORY TO DEPTH DISTRIBUTIONS IN HEATED TARGETS. DIFFUSION THEORY FOR DISCRETE MEDIA. PART II. Kelly, Roger (EURATOM, Ispra, Italy). Nucl. Instrum. Methods, 38: 181-4(1965).

Solutions of the diffusion equation appropriate for studying inert-gas depth distributions in heated targets were developed and were compared both with the observed distributions in heated Kr–Pt, Xe–Al, and Xe–W, and with the "penetrating tails" in distributions in unheated Xe–W. An exponential diffusion geometry with range R is assumed and allowance is made for trapping, e.g. for bubble formation, by means of the term $(k/2L^2)C$, where L is the diffusion length for trapping. Theory and experiment agree that the concentration near the surface falls with increasing kt, whereas the concentration at the greatest depths increases. A limiting form is finally reached for large kt such that, at moderate-to-large depths, the concentration is proportional to either exp (–x/L), for L > R, or exp (–x/R), for R > L. The limiting distribution is observed even when R is very small. Agreement between theory and experiment can also be shown in the value of L/R for Pt bombarded at 9 kev with Kr ions (9 kev Kr–Pt) and in the value for the fraction of gas trapped in 0.5 kev Kr–Pt. It is concluded that depth-distribution data provide a powerful tool both for obtaining diffusion parameters and for studying trapping. (auth)

20127 OXYGEN DIFFUSION IN QUARTZ STUDIED BY PROTON BOMBARDMENT. Palmer, Derek W. (Ecole Normale Superieure, Paris). Nucl. Instrum. Methods, 38: 187-91(1965).

A method to determine the distribution of the stable isotope ^{18}O in a solid, and its application to the study of the diffusion of ^{18}O in quartz, are described. The method involves measuring the energy spectrum of the α-particles produced from the reaction $^{18}O(p,\alpha)^{15}N$ by proton bombardment of the sample. Calculated α-particle spectra, which are in agreement with experimental results, indicate the validity of the method. (auth)

20128 RADIATION-ENHANCED DIFFUSION OF TRAPPED INERT GASES IN TUNGSTEN. Corkhill, D. P.; Carter, G. (The Univ., Liverpool). Nucl. Instrum. Methods, 38: 192-6(1965).

He, Ar, and Xe ions of energy between 200 ev and 4 kev were injected into polycrystalline tungsten surfaces and the quantity of gas trapped was observed as a function of dose, dose rate and time. Within the limits of experimental error the quantity trapped was observed to be dependent only upon the total ion dose (up to 10^{17} ions/cm^2) and not upon bombardment time (1 sec–10^4 sec). This suggests that radiation-enhanced diffusion of trapped gas does not occur upon time scales comparable to the experimental times for the combination of gas ion/target used. (auth)

20129 CRYSTAL LATTICE EFFECTS IN THE EMISSION OF CHARGED PARTICLES FROM MONOCRYSTALLINE SOURCES. Domeij, B. (Royal Inst. of Tech., Stockholm). Nucl. Instrum. Methods, 38: 207-9(1965).

^{222}Rn was injected into a tungsten single crystal cut perpendicular to the ⟨111⟩ direction and the intensity of α particles emitted in different directions was measured. In the ⟨111⟩ direction, the intensity is only one fourth of that in an arbitrary direction. The width of the minimum is about 2°. In the direction of the (110) planes, the intensity is down by about a factor of two. Higher index directions such as ⟨223⟩ and ⟨133⟩ were seen as well as (112) planes. Experiments involving variation of the

pertinent parameters are under way. A similar experiment measuring the intensity variation of conversion electrons emitted from ^{133}Xe in a Ta single crystal cut perpendicular to the ⟨100⟩ direction was performed. The dependence on emission angle is complex with a large number of maxima and minima. The K and L conversion lines show identical patterns in spite of the different energies. (auth)

20130 AN EXPERIMENTAL STUDY OF THE ORIENTATION DEPENDENCE OF (p,γ) YIELDS IN MONOCRYSTALLINE ALUMINUM. Andersen, J. U. (Univ. of Aarhus, Denmark); Davies, J. A.; Nielsen, K. O.; Andersen, S. L. Nucl. Instrum. Methods, 38: 210-15(1965).

The results are presented of recent investigations of the orientation dependence of the penetration of a proton beam through a crystal lattice (Al), using the (p,γ) resonance process to detect close collisions between protons and Al atoms. A very marked decrease in (p,γ) resonance yield is found whenever the beam is aligned within a small critical angle of one of the close-packed directions. In the most favorable case (the ⟨110⟩ direction), the yield is attenuated by about a factor of 10. There is also a smaller decrease in yield (about a factor of 2) whenever the beam is aligned with one of the close-packed planes in the crystal. The widths at half minimum of the dips are compared with the predictions of Lindhard's theory. The observed dips in (p,γ) yield were studied as a function of the depth beneath the crystal surface, at which the reaction is occurring. Within experimental error, the magnitude of the dips decreases exponentially with depth over a depth scale from a few hundred Ångström to several microns. The half value thickness varies from one low-index plane or direction to another. A preliminary investigation of the temperature dependence of the dip in the ⟨110⟩ direction was carried out. No temperature effect is observed below 100°C, but between 100–180°C, a definite decrease in magnitude of the dip occurs. (auth)

20131 EXPERIMENTAL INVESTIGATION OF ORIENTATION DEPENDENCE OF RUTHERFORD SCATTERING YIELD IN SINGLE CRYSTALS. Boegh, E.; Uggerhoej, E. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods, 38: 216-20(1965).

Theoretical and experimental work performed during the last year shows that the yield of processes like nuclear reactions or Rutherford scattering exhibit an extremely strong orientation dependence when the processes are taking place in a single crystal as a result of a bombardment with charged particles. When the charged particles enter the crystal within a certain critical angle of a low-index direction or plane, the yield is strongly decreased. This effect is explained as being due to the fact that the regularity of the crystal structure will steer the original aligned particles in trajectories which will never bring them closer than approx. 10^{-9} cm to the atomic nuclei in the crystal. Therefore, all processes requiring the particles to pass within this minimum distance of the nuclei cannot take place. It is described how measurements of Rutherford scattering yield have been used to demonstrate the effect and to obtain information about the steering process. In the measurements, very pronounced dips were found in the curve: yield versus angle between a proton beam and a low-index direction or plane in a single crystal. In some cases, the yield was reduced to be only 1–2% of the yield measured in the corresponding polycrystalline material. The reduction was found to depend on various parameters as for instance: the target material, the density of atoms along the direction at which the protons entered the crystal, and depth below the crystal surface where the detected scattering had taken place. The width of the dips was found to depend on the same parameters and on the energy of the particles. The results are compared with the theory given by Lindhard and show a good agreement with this. (auth)

20132 THE CHANNELING OF 2.5-Mev PROTONS IN Cu AND SOME EFFECTS OF TEMPERATURE AND RADIATION DAMAGE. Farmery, B. W. (Atomic Energy Research Establishment, Harwell, Eng.); Nelson, R. S.; Sizmann, R.; Thompson, M. W. Nucl. Instrum. Methods, 38: 231-7(1965).

Protons with energy in the region of 2.5 Mev were passed through single crystals of copper, 10 μm in thickness and their energy spectrum analysed by a solid-state detector. The angular spread of the proton beam was less than ±0.06° and when it was incident within ±1° of the ⟨110⟩ axis of the crystal the energy spectrum showed that a distinct group of particles came through, with about one half the normal energy loss. This is interpreted as further evidence of the channelling effect in Cu, and is compared with previous experiments in which the effect of orientation on the Cu (p,n)Zn reaction was studied. The effect of several solid-state parameters on the channelled group of protons was investigated. First the temperature was altered in the range 180°–520°K and the channelling was found to decrease with increasing temperature. The variations seem in accord with current theories which relate the changes to lattice vibration amplitudes. Next the crystal was damaged by irradiating with 1.5 Mev protons at a temperature below 190°K to a dose sufficient to make more than 1% of the atoms suffer displacement, though at this temperature the retained percentage of point defects must be much less than this. The channelled fraction was reduced by 20%, which seems to indicate that radiation damage introduces a channel-blocking effect. An order-of-magnitude estimate predicts the correct magnitude for this observation. (auth)

20133 DEFECT DISTRIBUTIONS IN CHANNELING EXPERIMENTS. Andersen, H. H. (AEK Risoe, Roskilde, Denmark); Sigmund, P. Nucl. Instrum. Methods, 38: 238-40(1965).

A simple collision model is used to calculate energy losses of perfectly channeled particles. The maximum energy loss is related in a simple way to the displacement energy of lattice atoms perpendicular to the channel. From that, one obtains rather definite predictions on the possibility of radiation damage by channeled particles. As an application, one gets a necessary criterion for the occurrence of super tails in channeling experiments. The theory involves some assumptions on the behavior of Born-Mayer potentials which are verified by comparison to experimental displacement energies. (auth)

20134 THE RANGES OF FAST HEAVY PARTICLES IN SOLIDS. SOME EXPERIMENTAL AND THEORETICAL RESULTS. Lutz, H.; Schuckert, R.; Sizmann, R. (Technische Hochschule, Munich). Nucl. Instrum. Methods, 38: 241-4(1965).

Calculations for fast copper particles (5 and 20 kev) moving in a copper lattice were performed on a computer (Telefunken TR4). The equations of motion were integrated to first approximation considering the elastic interaction with the 6 nearest neighbor atoms and the inelastic interaction proportional to velocity. Range distributions were obtained for incidence on a random lattice as well as on a fcc-lattice in ⟨111⟩ and the results were compared to each other. In the latter case the periodic lattice structure highly influences the motion of the fast particles. Channeling of 70 kev ^{85}Kr ions in gold single crystals was studied experimentally. The direction of the incident beam was varied in small steps between ⟨110⟩ and ⟨111⟩, while always being parallel to {110}. An effective angle of the 110-channel (about 3°) was found, but even at 111-incidence particles with long ranges were observed. (auth)

20135 THE RANGE OF HEAVY IONS (0.1-1.5 Mev) IN MONOCRYSTALLINE TUNGSTEN. Davies, J. A.; Eriksson, L.; Jespersgaard, P. (Univ. of Aarhus, Denmark). Nucl. Instrum. Methods, 38: 245-8(1965).

Channeling effects on the range and range straggling of atomic beams in the energy region 0.1 to 1.5 Mev were investigated in tungsten crystals. The observed range distributions show two peaks – corresponding to unchanneled and channeled portions of the incident beam. The range of the channeled component has an energy exponent approaching 0.5 to 0.6, indicating that electronic stopping is the dominant mechanism of energy loss. The stopping power

values of channeled ions are approximately three times smaller than the predicted electronic stopping powers in amorphous tungsten. Moreover, at the same incident velocity, the maximum ranges of various projectiles oscillate with Z_1 in the same peculiar manner as has been reported for electronic stopping in carbon and aluminum. Some experiments performed with precise target orientation show that in order to get quantitatively reproducible range distributions, the crystal should be aligned to within tenths of a degree of the desired orientation. Maximum ranges, however, are shown to be fairly insensitive to small misorientations (1°). Range measurements in oriented crystals provide an interesting method of studying electronic stopping. The experiments are continued. (auth)

20136 RANGES OF HEAVY IONS. Brown, F.; Ball, G. C.; Channing, D. A.; Howe, L. M.; Pringle, J. P. S.; Whitton, J. L. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods, 38: 249-53(1965).

A brief outline is presented of some recent measurements of the ranges of kev heavy ions in solids. Typical results are given for (a) ranges of ^{133}Xe and ^{198}Au ions in single crystal Au, (b) effect of target temperature on heavy ion channeling in crystals of Au and Al, (c) ranges of ^{125}Xe ions in amorphous Ta_2O_5 and (d) ranges of ^{133}Xe ions in crystals of UO_2. A more detailed account is given of experiments to determine how ranges in crystals vary with ion mass at constant ion velocity. (auth)

20137 USE OF THE D-D REACTION TO INVESTIGATE PENETRATION OF 20 kev DEUTERONS IN GOLD AND ALUMINUM. Chu, Y. Y.; Friedman, L. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Instrum. Methods, 38: 254-9(1965). (BNL-9385).

Neutrons produced in the D-D reaction were used to measure the depth of penetration of 20-kev deuterons in gold and aluminum targets. Separate targets were bombarded with beams of D^+, D_2^+ and D_3^+ having energies of 20, 40 and 60 kev, respectively. After amounts of D atoms ranging from 2×10^{15}–10^{17} had been accumulated, these targets were then bombarded for relatively short time periods with D^+ beams ranging in energy from 20–60 kev. The number of fusion events in the target was measured by the neutrons produced which were counted in calibrated geometry. The energy dependence of the cross section of the D-D reaction is well known and the energy loss of deuterons in the kev range in these materials can be calculated from electronic stopping power theory, so that the necessary information for unfolding the data of neutron counts per unit intensity of probe D beam at each bombarding energy was available. The distributions obtained indicated larger amounts of deuterons deposited near the surface of the targets than expected from energy loss estimates of range. A remarkable effect of chemical constitution of the incident D_3^+ beam was observed which shows a significantly reduced range of deuterons from D_3^+ compared with deuterons from D^+ and D_2^+. This is cited as an example of self-created radiation enhanced diffusion. (auth)

20138 DIFFUSION OF RARE EARTHS THROUGH TANTALUM. Andersen, M. L.; Nielsen, O. B.; Scharff, B. (Univ. of Copenhagen). Nucl. Instrum. Methods, 38: 303-5(1965).

In isotope separator "on line" preparations of short-lived radioactive sources the application of targets of considerable thickness seems to be unavoidable for intensity reasons. Diffusion is apparently the only process capable of transporting the active atoms to the surface of the target. In order to investigate the possibilities for applying this technique to non-volatile compounds such as the rare-earth elements, the diffusion times of radioactive rare-earth activities through tantalum were studied. The activities were produced in the tantalum by bombarding a 0.2 mm foil with ~600 Mev protons in the CERN synchrocyclotron. The tantalum was heated as a filament or by electron bombardment inside a vacuum evaporation chamber, and the time needed for diffusion to the surface and subsequent evaporation was studied as a function of temperature. Time delays of the order of seconds were found for temperatures just below the melting point of tantalum. (auth)

20139 MOESSBAUER ISOMER SHIFTS IN ^{127}I AND ^{129}I. Reddy, K. Rama; De Sousa Barros, F.; Debenedetti, S. (Carnegie Inst. of Tech., Pittsburgh). Phys. Lett., 20: 297-8(Feb. 15, 1966).

The investigations of the Mössbauer isomer shifts in iodine-127 and iodine-129 in potassium iodide, potassium iodate, and sodium periodate were conducted with the source and absorbers at liquid hydrogen temperatures. The isomer shifts of these absorbers are listed. Also the Mössbauer spectra for sodium-para-periodate containing ^{127}I and ^{129}I are given. (J.F.P.)

20140 EVIDENCE FOR EXCHANGE COUPLING IN THE ABSORPTION SPECTRUM OF $NdCl_3$. Prinz, G. A. (Johns Hopkins Univ., Baltimore). Phys. Lett., 20: 323-4 (Mar. 1, 1966).

High-resolution absorption spectra of $NdCl_3$ show that each line is accompanied by two satellites of comparable intensity arising from an anisotropic (near-neighbor fictitious spin) exchange coupling of the form $H_{n-n} = T_{ij}S_{i_z}S_{i_z}$. For the ground state, $T_{ij} = 1.62\ cm^{-1}$ (antiferromagnetic). (auth)

20141 THE MAGNETIC PROPERTIES OF $Gd_{1-x}Y_xCo_2$ COMPOUNDS. Taylor, K. N. R.; Ellis, H. D.; Darby, M. I. (Univ. of Durham, Eng.). Phys. Lett., 20: 327-8 (Mar. 1, 1966).

The magnetic properties of a series of compounds $Gd_{1-x}Y_xCo_2$ were measured. A model is proposed, to account for the anomalous magnetization curves which occur in this type of material. (auth)

20142 COMPUTER SIMULATION OF THE VARLEY MECHANISM. Chadderton, L. T.; Morgan, D. V.; Torrens, I. McC. (Cavendish Lab., Cambridge, Eng.). Phys. Lett., 20: 329-31(Mar. 1, 1966).

Computer simulations of lattice relaxation during the Varley mechanism in KCl provide no evidence for the model originally proposed. Nevertheless, possible modes of Frenkel defect production for triple and quadruple ionization are indicated. (auth)

20143 MAGNETIC PHASES IN RARE EARTH CHLORIDES. Marsh, J. M. (Johns Hopkins Univ., Baltimore). Phys. Lett., 20: 355-6(Mar. 1, 1966).

Recent spectroscopic measurements by Prinz of the exchange coupling in $NdCl_3$ are reconciled with the magnetic susceptibility data of Eisenstein et al. (auth)

20144 ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED GRAPHITIZED CARBON BLACK. Kester, T.; Servoz-Gavin, P. (Centre d'Etudes Nucleaires, Grenoble, France). Phys. Lett., 20: 357-9(Mar. 1, 1966).

Electron spin resonance of neutron irradiated graphitized carbon black was studied in the temperature range of 4–300°K. The temperature dependences of the susceptibility χ, g-value and width ΔH of the resonance line are discussed. (auth)

20145 THERMAL RELEASE OF ^{133}Xe INJECTED BY ION BOMBARDMENT INTO MONOCRYSTALLINE COPPER TARGETS. Perovic, B.; Jokic, T. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Phys. Lett., 20: 485-6 (Mar. 15, 1966).

Experiments are reported on thermal release of gas embedded by ion bombardment into monocrystalline targets. (auth)

20146 NUCLEAR ORIENTATION OF ^{140}La, ^{154}Eu, ^{159}Gd, ^{177}Lu, AND ^{177m}Lu BY STERNHEIMER ANTISHIELDING. Blok, J.; Shirley, D. A. (Univ. of California, Berkeley). Phys. Rev., 143: 911-17(Mar. 18, 1966). (UCRL-16328).

Five rare-earth nuclei were oriented in neodymium ethyl sulfate and/or cerium magnesium nitrate lattices at very low temperatures, by utilizing the amplification of the crystal-field gradient (by a factor of $\sim 10^2$) provided by Sternheimer antishielding. The following quadrupole coupling constants P were obtained in the ethylsulfate

lattice (units of 10^{-5} cm^{-1}): ^{140}La, −1.42(12); ^{154}Eu, −41.7 (28); ^{159}Gd, −144(5); ^{177}Lu, −67(3); ^{177m}Lu, −13.0(12); and in the double nitrate lattice: ^{140}La, + 1.10(16); ^{154}Eu, +1.5(1). The quadrupole moment for ^{140}La was found to be +0.127(13) b. The ratio of Q ^{177m}Lu/Q (^{177}Lu) is +2.33 (25). The 815-kev γ ray in ^{140}Ce has δ(E2/M1) = −0.11(5), if taken last in cascade. The signs and magnitudes of ($g_K - g_R$) for the $^7/_2$−[514] band and the $^9/_2$+[624] band in ^{177}Hf were determined. Of special interest is the retention of nuclear orientation through the ~1-sec isomeric states in ^{177}Hf. (auth)

20147 NORMAL AND ANOMALOUS PHOTOELECTRIC ABSORPTION OF X RAYS IN CRYSTALS. **Wagenfeld, H. (Univ. of Melbourne, Parkville, Victoria). Phys. Rev., 144: 216-24(Apr. 8, 1966).**

The photoelectric absorption of x rays in atoms (K-, L-, and M-shell) is discussed for the nonrelativistic region, taking retardation effects into account. This is done by expanding the retardation factors in the transition probabilities in a Taylor series and this corresponds to an expansion in terms of electric multipoles. This expansion converges very rapidly and even the octupole transitions may be neglected. In the case of the anomalous absorption of x rays in perfect single crystals (Borrmann effect), the absorption cross sections become angular-dependent. This angular dependence allows in principle a direct experimental determination of the quadrupole term of the atomic photoelectric absorption cross section. Previous measurements indicate the existence of the electric quadrupole transitions. (auth)

20148 MOESSBAUER EFFECT IN ^{125}Te. **Violet, Charles E.; Booth, Rex (Univ. of California, Livermore). Phys. Rev., 144: 225-31(Apr. 8, 1966). (UCRL-12438).**

The Mössbauer effect associated with the 35.6-kev transition of ^{125}Te was investigated in the host materials ZnTe, MnTe, βFeTe, Te, TeO_2, Na_1TeO_3, TeF_3, TeI_4, Cu, and $NaIO_3$. Quadrupole splitting is not observed in host materials of cubic symmetry, i.e., ZnTe and Cu. The host materials of noncubic symmetry all exhibit quadrupole splitting. The quadrupole splitting in Te at 4.8°K is (0.90 ± 0.03) × 10^{-6} eV (0.76 ± 0.02 cm/sec). The temperature dependence of the quadrupole splitting in Te between 4.8 and 77.9°K implies a molecular torsional frequency of ≈6 × 10^{12} sec^{-1}. ^{125}I incorporated into a Cu matrix as a Mössbauer source gives a single resonance line, while ^{125}I in a $NaIO_3$ source gives four resonance lines. The latter spectrum is interpreted on the hypothesis that ^{125}Te is produced in two observable charge states following the decay of ^{125}I in $NaIO_3$. The two charge states may result from K x-ray and Auger transitions following the ^{125}I decay. In this model the higher charge state decays by electron capture with a half-life of ≈1.6 × 10^{-9} sec. The recoilless fraction for the Cu source at 82°K is ≈0.2. In $NaIO_3$ it is 0.14 (82°K) and 0.28 (4.8°K). This corresponds to an apparent $NaIO_3$ Debye temperature of ≈155°K. (auth)

20149 SPIN-SPIN RELAXATION IN LaF_3. **Goldman, M.; Shen, L. (Washington Univ., St. Louis). Phys. Rev., 144: 321-31(Apr. 8, 1966).**

A study was made by nmr pulse techniques of the motion of fluorine atoms in lanthanum trifluoride as a function of temperature, between 100 and 560°C. The experiments were conducted with a single crystal of LaF_3. The model for the motions derived from this study is the following: There are two types of fluorine nuclei, the spins I and the spins S, located on different sublattices. Between 100 and 300°C, the motion of the spins I is fast (i.e., such as to be appreciable in times shorter than the reciprocal of the rigid-lattice line width), and the motion of the spins S is slow. There is an exchange of atoms between the two sublattices, the rate of which is slow up to about 300°C and fast at higher temperature. The ratio of populations of the spins I and S is $N_I/N_S = 2$. Approximate values are derived for the activation energies associated with these two types of motion. (auth)

20150 DEBYE-WALLER FACTOR AND SECOND-ORDER DOPPLER SHIFT OF ^{129}I IN ALKALI IODIDES. **Jaswal, S. S. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 144: 353-6(Apr. 8, 1966).**

The Debye-Waller factor (or recoilless fraction) and the second order Doppler shift of ^{129}I in alkali iodides of NaCl structure were calculated as a function of temperature corresponding to a transition of 26.8 kev in ^{129}I. In each case, the lattice-vibration eigenfrequencies and eigenvectors required in these calculations are calculated for 8000 points in the first Brillouin zone using the deformation-dipole model for the lattice. In this model the short-range forces, long-range Coulomb forces, polarization and deformation of the ions are taken into account. The results for the recoilless fraction are in agreement with those of the Mössbauer experiments, whereas calculations based on nearest-neighbor short-range interactions show very poor agreement with the experimental results. Thus, the nearest-neighbor-interaction model is very inadequate for calculations in alkali halides and a more realistic model like the deformation-dipole model should be employed in order to compare the theory with the experiment. The results for the second-order Doppler shift approach the same value in the high-temperature limit while at very low temperature the maximum variation is about 5% in all the cases. Thus, to indicate the behavior of this quantity as a function of temperature, the results are given for one of these compounds only. (auth)

20151 MEASUREMENT OF THE ABSOLUTE KNIGHT SHIFT IN LITHIUM. **Schumacher, R. T.; VanderVen, N. S. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 144: 357-60(Apr. 8, 1966).**

The absolute Knight shift of ^7Li in lithium metal was measured by observing the ^7Li nuclear resonance frequency as a function of conduction-electron paramagnetism. The latter was varied by saturating the conduction-electron spin resonance with microwave power. By using two slightly different techniques K = 243 ± 10 ppM and K = 253 ± 8 ppM were obtained. Some of the difficulties and inherent uncertainties of the experiment are discussed in detail. (auth)

20152 NEUTRON-DIFFRACTION STUDIES OF ELECTRON-SPIN PAIRING IN SUPERCONDUCTING V_3Si. **Shull, C. G.; Wedgwood, F. A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Lett., 16: 513-15(Mar. 21, 1966).**

The coherent magnetic scattering of polarized neutrons that arises with the magnetization of V_3Si single crystals by an externally applied magnetic field was studied. The results show that the magnetic susceptibility in this paramagnetic material arises partly from 3d electron-spin polarization and partly from 3d orbital magnetization, with the former disappearing at temperatures sufficiently below the superconducting transition temperature of 16.8°K. (D.C.W.)

20153 RELAXATION NARROWING OF MOESSBAUER GAMMA RAYS. **Dash, J. G.; Nussbaum, R. H. (Univ. of Washington Seattle). Phys. Rev. Lett., 16: 567-70 (Mar. 28, 1966).**

The existence of a class of naturally occurring relaxation phenomena which may cause changes in resonance line shapes, including broadening and narrowing to less than natural linewidths, in measurements on Mössbauer gamma rays due to atomic and solid state effects is discussed. One example, the excitation of localized lattice vibrational modes, is thoroughly examined. (B.G.D.)

20154 ELECTRIC QUADRUPOLE-QUADRUPLE INTERACTION BETWEEN CERIUM PAIRS IN LANTHANUM CHLORIDE. **Birgeneau, R. J.; Hutchings, M. T.; Rogers, R. N. (Yale Univ., New Haven). Phys. Rev. Lett., 16: 584-6(Mar. 28, 1966).**

A direct quantitative measurement of the electric quadrupole-quadrupole interaction between pairs of Ce^{3+} ions in $LaCl_3$ is presented. The EPR spectra of 1% Ce^{3+} in $LaCl_3$ were observed at 4.2°K and 25 Gc, and nearest-

neighbor and next-nearest-neighbor pair transitions were identified. (B.G.D.)

20155 OSCILLATORY FIELD DEPENDENCE OF THE KNIGHT SHIFT IN A MONOCRYSTAL OF TIN. Reynolds, J. M.; Goodrich, R. G.; Khan, S. A. (Louisiana State Univ., Baton Rouge). Phys. Rev. Lett., 16: 609-10(Apr. 4, 1966).

Measurements of the ^{119}Sn nuclear magnetic resonance signal as a function of magnetic field in a monocrystal of white tin at 1.35°K show an oscillatory field dependence of the Knight shift. The existence of oscillations in the NMR frequency in metals superimposed on the normal linear dependence on magnetic field, which has been predicted, is definitely observed when the Knight shift is measured in the field range of 11.5 to 12.5 kG. (B.G.D.)

20156 CRYSTAL STRUCTURE OF DEUTERIUM AT LOW TEMPERATURES. Schuch, A. F.; Mills, R. L. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 16: 616-18(Apr. 4, 1966). (LA-DC-7763).

An experimental investigation of the structure of solid deuterium in the neighborhood of its λ anomaly by x ray diffraction is discussed. Results of the diffraction patterns show that the deuterium solid is a conglomeration of crystallites. The structures being sometimes hcp and sometimes fcc lattice, and in several cases, both crystal forms are observed. (B.G.D.)

20157 NUCLEAR MAGNETIC RESONANCE OF ^{115}In AND ^{209}Bi IN SOME LIQUID BINARY ALLOYS. Seymour, E. F. W.; Styles, G. A. (Univ. of Leeds, Eng.). Proc. Phys. Soc. (London), 87: 473-83(Feb. 1966).

The Knight shift of the ^{115}In resonance was measured as a function of composition in the liquid alloy systems In–Cd, In–Hg, In–Tl, In–Sn, In–Pb and In–Bi, and of the ^{209}Bi resonance in In–Bi. The changes in shift follow no simple pattern and show no correlation with valency difference or ionic size difference. The results are not explicable by the theory of electron density fluctuations used successfully by Blandin and Daniel to explain changes in shift in silver-base solid solutions. The results for In–Bi point to the existence of intermetallic compounds in the liquid state. Linewidths are consistently larger than expected from the Korringa relation, probably owing to electric quadrupole interactions. (auth)

20158 THE THEORY OF INELASTIC SCATTERING OF NEUTRONS IN FERROMAGNETIC CRYSTALS CONTAINING IMPURITIES. Izyumov, Yu. (Oxford Univ.). Proc. Phys. Soc. (London), 87: 521-34(Feb. 1966).

The cross section of one-magnon neutron scattering in a crystal containing a low concentration of impurities is calculated. When the energy transfer is less than the widths of the band of the quasi-continuous spectrum of spin excitations the one-magnon scattering consists of two parts, coherent and incoherent, with effective scattering amplitudes depending on the energy transfer. The widths of the peaks in the energy distribution of neutrons coherently scattered by spin waves are calculated and it is shown that the widths have a resonance character near an energy transfer corresponding to the levels of quasi-localized states of s, p or d type. The cross section of the incoherent scattering shows a resonance only near the level of a quasi-localized s state. When the energy transfer is larger than the width of the band, neutrons are scattered by localized modes of s, p and d type. This scattering is incoherent and the amplitudes of scattering by localized modes of different types have a different angular dependence, the observation of which should allow the determination of the degree of localization of the corresponding states in the crystal. (auth)

20159 THE SYMMETRY OF AN N CENTRE IN SODIUM CHLORIDE. Hughes, A. E. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Phys. Soc. (London), 87: 535-42(Feb. 1966).

The symmetry of the color center giving rise to an absorption line at 8373 Å in the N-band region of irradiated sodium chloride was determined by the application of uniaxial stress to the crystal. The stress splitting patterns indicate that the center has monoclinic symmetry, and the results are compared with those obtained previously on similar zero-phonon lines in lithium fluoride and sodium fluoride. The phonon-assisted transitions accompanying the line are compared with recent calculations of the vibrational spectrum of sodium chloride. (auth)

20160 ON THE CRYSTAL STRUCTURE OF SOLID DEUTERIUM. Blackman, M.; Curzon, A. E. (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 87: 588-9(Feb. 1966).

Criticisms made by Mucker et al. (Phys. Rev. Letters, 15: 586 (1965)) of the paper by Curzon and Pawlowicz (Proc. Phys. Soc., 83: 888 (1964)) on the crystal structure of solid deuterium are discussed and commented on. (auth)

20161 ELECTRON SPIN RESONANCE SPECTRUM OF THE CO_2^- RADICAL ION AT 77 DEG K. Bennett, J. E.; Mile, B.; Thomas, A. (Thornton Research Centre, Chester, Eng.). Trans. Faraday Soc., 61: 2357-64(Nov. 1965).

CO_2^- radical ions were prepared by depositing sodium or potassium on solid carbon dioxide at 77°K in the rotating cryostat. The electron spin resonance spectra show that the CO_2^- radical ions have the same configuration as the ions in γ-irradiated sodium formate, which are bent with an OĈO angle of about 134°. A small hyperfine coupling to the alkali metal nucleus shows that the unpaired electron is not completely transferred to the carbon dioxide molecule, but is retained partially in the 3s orbital of the sodium or 4s orbital of the potassium. The contributions of the s-orbitals to the structure of the ion-pair are 7.2% for sodium and 6.7% for potassium. With potassium the CO_2^--alkali metal ion pairs are located almost entirely in one site, in which they are relatively unaffected by their environment. However, with sodium the ion pairs exist in several sites and the one with the greatest hyperfine coupling from the sodium atom corresponds to that found for potassium. The smaller hyperfine coupling in the other sites is attributed to increased coordination of the sodium with neighboring carbon dioxide molecules. The alkali-metal hyperfine couplings observed in the carbon dioxide matrix are markedly different from those found for the corresponding ions formed by γ-irradiation of sodium and potassium formate. This difference is attributed to greater coordination of the ion-pair in the formate crystals. (auth)

20162 MOESSBAUER SPECTROSCOPY AND ITS APPLICATIONS TO METALS. Gonser, Ulrich (North American Aviation Science Center, Thousand Oaks, Calif.). Z. Metallk., 57: 85-96(Feb. 1966). (In German).

The principles of Mössbauer spectroscopy and its significanee and applications to metals are described. The Mössbauer parameters, such as isomeric shift, nuclear Zeeman effect, quadrupole splitting, relativistic effects, line width, and recoil free fraction are discussed. Different examples are given. (auth)

20163 DENSITY CHANGES AND F-CENTER CONCENTRATION IN KCl BY X-IRRADIATION AT ROOM TEMPERATURE. Bleckmann, A.; Thommen, K. (Univ., Bonn). Z. Phys., 191: 160-76(Feb. 1966). (In German).

F-center concentrations and density changes in KCl single crystals, brought about by x-irradiation at room temperature, were measured. The density measurements were made using a flotation technique. Both undoped KCl crystals and crystals doped with KH were investigated. The following results were obtained: (1) In Korth-KCl crystals (undoped) the volume change per F-center in stage I of the coloration–i.e. where the so-called fast coloration process is predominant–was $(1.34 \pm 0.04)a^3$ (a: interionic distance). (2) In KCl:KH crystals the volume change per F-center in stage I was $(1.12 \pm 0.04)a^3$. Assuming that in stage I all F-centers were formed from U-centers, the volume change due to lattice relaxation around the hydrogen-interstitials was estimated to be $(0.7 \pm 0.2)a^3$ per ejected hydrogen atom. (3) In Harshaw KCl crystals (undoped) the volume change per F-center in stage II was $(1.36 \pm 0.04)a^3$. These

data suggest that in the fast coloration process (stage I) anion vacancies are created by the ejection of impurity ions from anion lattice sites. Furthermore it is shown that the value of the volume change per F-center in stage II is in much better agreement with a Frenkel-defect production mechanism than with a Schottky-defect production mechanism. An explanation is offered for the discrepancy between the results of Rabin and the results of this work. (auth)

20164 NEUTRON SPECTROSCOPY OF THE CONDENSED STATE OF MATTER. Larsson, Karl-Erik (Royal Inst. of Tech., Stockholm). pp 93-116 of STI/DOC/56(Vol.II).

A review of elastic and inelastic nuclear or magnetic scattering is presented with particular attention to the use of slow neutron properties of solids and liquids. A brief outline of what is being done in the field of slow neutron spectroscopy of solids and liquids and a discussion of necessary apparatus, manpower, and organization is presented. (B.G.D.)

20165 A REVIEW OF THE ELASTIC AND INELASTIC MAGNETIC SCATTERING OF NEUTRONS. Riste, T. (Nuclear Research Center Democritos, Athens). pp 117-26 of STI/DOC/56(Vol.II).

A review is presented on the elastic and inelastic magnetic scattering of neutrons, limited to cases where the moment of the scatterer is due to the unpaired electron spin of its atoms and the assumption that the magnetic substance is crystalline. The neutron is utilized in studying the magnetic phenomena originating from magnetic exchange forces between the magnetic atoms or ions. A summary of experimental equipment for magnetic neutron scattering studies is also included. (B.G.D.)

20166 SIZEABLE DYNAMIC PROTON POLARIZATIONS [Thesis]. Schmugge, Thomas Joseph. Berkeley, Calif., Univ. of California, 1965. 137p.

The dynamic polarization of the protons in the waters of hydration in the crystal $(Nd,La)_2Mg_3(NO_3)_{12}\cdot 24H_2O$, which occurs when one saturates a microwave "forbidden" transition that simultaneously flips a proton and a Nd^{3+} ion was studied. The dynamics of the polarization process, as well as the proton relaxation process, are discussed in terms of a phenomenological shell-of-influence model. A polarization apparatus is described for use at microwave frequencies between 35 and 75 kMc and at liquid helium temperatures. Proton relaxation rates T_{1p}^{-1} were measured over a wide range of fields $0.5 \leq H \leq 21.8$ kOe and temperatures $1.4 \leq T \leq 4.2$°K and are found to be in agreement with the predicted rate $T_{1p}^{-1} \approx T_{1e}^{-1} (g_{Nd}\beta/H)^2(r^{-6})_{av}$, where T_{1e}^{-1} is the relaxation rate for the Nd^{3+} ion, r is the separation between proton and ion, and the average is taken over the shell-of-influence. Dynamic proton polarization measurements were made over a wide range of frequencies and temperatures; at 75 kMc and 1.5°K a polarization of approximately 70% was obtained. The dependence of the polarization on microwave power, magnetic field and its transient behavior were observed and are qualitatively explained. At these high polarizations, the proton magnetic resonance line shape changes and a structure appears, due to the freezing-in of the local dipolar fields. At complete polarization a local field computation predicts a series of 24 sharp proton lines. The crystal studied was used successfully in the construction of a polarized proton target. (Dissertation Abstr.)

20167 FERMI SURFACE AND BAND GAP IN BERYLLIUM; POSITRON TEMPERATURE IN SODIUM [Thesis]. Shand, Julian Bonham Jr. Chapel Hill, N. C., Univ. of North Carolina, 1965. 96p.

Positron annihilation experiments carried out on oriented single crystals of beryllium showed that the Fermi surface is quite anisotropic. Effects due to higher momentum components of the electronic wave functions were observed. It was not possible to work from the data to obtain the details of the Fermi surface. A calculation of the Fermi surface of beryllium was made, using a simplified orthogonalized plane wave approach and a pseudopotential. Matrix elements of the pseudopotential were needed for determining the Fermi surface. Certain simplifying assumptions were made, which allowed each matrix element to be factored into structure factor times an OPW form factor. Structure factors and OPW form factors were calculated and used to determine the Fermi surface. It was found that the OPW form factors had to be shifted to slightly higher values to agree with certain facts from the de Haas-van Alphen experiments. It was concluded that the simplified methods were useful but not completely adequate for beryllium. If the energy gaps at zone faces are known the effect on positron annihilation data of the higher momentum components of the electronic wave functions can be predicted. A particularly simple case is the (0,0,2) direction in beryllium. The angular correlation of photons from positrons annihilating in sodium was measured experimentally at various temperatures. The sharpness of the cut-off decreased with increasing temperatures. The momentum distribution of the positrons was assumed to be Maxwell-Boltzmann. To fit the data it was necessary to use an effective temperature equal to (1.7 ± 0.4) times the actual temperature of the sodium sample. (Dissertation Abstr.)

20168 THERMAL EXPANSION OF THULIUM AND YTTERBIUM OXIDES BELOW ROOM TEMPERATURE [Thesis]. Davenport, James Clinton. Washington, D. C., Howard Univ., 1965. 37p.

In order to study thermal expansion of thulium and ytterbium oxides below room temperature, a special cryoflask was built and a very sensitive temperature control system was designed and set up. A method for deriving the dimensions of the unit cell at different temperatures from the diffraction of the x rays was devised, which did not use standards but used the α_1 and α_2 components of the x radiation. All calculations were made on an IBM 1620 computer. In contrast to results previously obtained above room temperature, an increase in the unit cell dimensions with decreasing temperature was observed. Tm_2O_3 crystallizes in the C-modification of the rare earth sesquioxides. It is cubic, isotypic with Mn_2O_3 ($D5_3$ type). The lattice constant was found to be 10.4882 Å at 291°K and 10.4716Å at 104°K. Yb_2O_3 has the same structure as Tm_2O_3. The lattice parameter was found to be 10.4333 at 300°K and 10.4234 at 104°K. (A.G.W.)

20169 FERMI SURFACE OF SODIUM AND LITHIUM BY POSITRON ANNIHILATION [Thesis]. Donaghy, James Joseph. Chapel Hill, N. C., Univ. of North Carolina, 1965. 89p.

The momentum distribution of annihilation photons was measured for positrons annihilating in single crystals of sodium and lithium. The data yield information related to the areas of slices through the Fermi surface normal to the (110), (100), and (111) directions. An analysis of the data was made using a phenomenological model of the Fermi surface. On the basis of this analysis, the following conclusions were reached: (1) the Fermi surface of sodium is spherical within the experimental error of 1.5%; and (2) the Fermi surface of lithium is distorted, k_{110} being about 5% greater than k_{100} or K_{111}. The data indicate that it is very unlikely that the Fermi surface in lithium actually touches the boundary of the first Brillouin zone. The measurements also indicate that the annihilation cross section is velocity-dependent. The annihilation rate is found to be greater for the faster moving electrons, in accordance with recent calculations. A rough estimate, based on the almost-free electron approximation, was made of the intensity of the higher momentum components in lithium. These estimates are consistent with an energy gap of about 3 ev at the zone boundary. (Dissertation Abstr.)

20170 THERMAL VIBRATIONS OF CRYSTAL LATTICES. Dolling, G.; Woods, A. D. B. (Atomic Energy of Canada, Ltd., Chalk River, Ont.). pp 193-249 of Thermal Neutron Scattering. Egelstaff, P. A. (ed.). London, Academic Press, 1965.

A survey on the use of the inelastic scattering of slow neutrons to study the lattice dynamics of solids is presented. Experimental observations on metals and superconductors are compared with theoretical predictions. 161 references. (D.C.W.)

20171 REPORT, 4th ALL-UNION CONFERENCE ON FERROELECTRICITY, ROSTOV-ON-THE-DON, USSR, SEPTEMBER 12–18, 1964. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1966-2128(Nov. 1965). (In Russian). (CONF-640917).

Thirty-nine papers are included. Separate abstracts were prepared for four. Papers not abstracted are on ir crystalline absorption spectra; pyroelectric effects, relaxation phenomena, dielectric properties, optical properties, polarization, uhf dispersion, hysteresis, and the Curie point in ferroelectric crystals; the internal fields, preparation, and properties of ferroelectric solid solutions; dielectric properties, electric-field effects, hysteresis, relaxation phenomena, piezoelectric effect, and polarization in ferroelectric ceramics; ferroelectric films; and the use of ferroelectrics in uhf systems. See NSA 20: 2526 for the abstract of the other papers presented at this conference. (M.J.T.)

For abstracts of individual papers see: 20172–20175.

20172 PHASE STABILIZATION IN γ-IRRADIATED FERROELECTRIC MATERIALS. Yurin, V. A. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 2000-4(Nov. 1965). (In Russian).

The ferroelectric and structural properties of Rochelle salt gamma-irradiated with doses from 0.4 to 10 MR were studied, at temperatures from −40 to +40°C. Peculiarities of the phase transitions in the irradiated crystals are discussed. Effects on the domain structure in crystals irradiated at 3°C, in the monoclinic phase, and at 35°C, in the orthorhombic phase, are considered. The temperature dependence of the dielectric permeability and the effects of various radiation doses on the positions of the Curie points are shown for Rochelle salt irradiated at 3°C. The temperature variations of the extinction angle of the domains for crystals irradiated at 3°C are also shown. Gamma-induced phase stabilization in a hydrogenous ferroelectric, triglycine sulfate, is illustrated by showing the temperature dependence of the pyroelectric polarization before and after irradiation with 9 MR. (M.J.T.)

20173 PIEZOELECTRIC EFFECT AND INTERNAL FRICTION IN γ IRRADIATED ROCHELLE SALT CRYSTALS. Sil'vestrova, I. M.; Yurin, V. A.; Shuvalov, L. A.; Podlesskaya, A. V. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 2005-8(Nov. 1965). (In Russian).

The piezoelectric modulus d_{14}, the electromechanical coupling constant k_{14}, the elastic compliance s'_{22}, and the damping constant δ for longitudinal mechanical vibrations were measured in γ-irradiated 45°-X-cut Rochelle salt crystal bars at temperatures from 0 to 35°C and, for s'_{22} and d_{14}, in a d-c bias field up to 3 kv/cm. The crystals were irradiated with doses from 0.5 to 12 MR at 3 to 5°C and stored at this temperature for 1 to 2 days before measurement. The sharp maxima in the measured quantities at the Curie point were reduced in magnitude, broadened, and shifted to lower temperatures, in the irradiated samples. In the most highly irradiated samples, the measured quantities were all nearly temperature-independent. In unirradiated samples both s'_{22} and d_{14} showed sharp maxima at zero bias. The effect of increasing irradiation was to broaden these maxima, shift them to higher bias fields, and finally to wash them out. The occurrence of maxima in s'_{22} and d_{14} at nonzero bias fields was associated with the appearance of double hysteresis loops. (M.J.T.)

20174 INFLUENCE OF γ-IRRADIATION ON THE BARKHAUSEN EFFECT IN FERROELECTRIC MATERIALS. Shuvalov, L. A.; Rudyak, V. M.; Komlyakova, N. S.; Kamayev, V. E. (Inst. of Crystallography, Academy of Sciences, SSSR Kalinin State Pedagogical Inst., SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 2009-13(Nov. 1965). (In Russian).

The Barkhausen effect was investigated in γ-irradiated Y-cut triglycine sulfate and X- and 45°-X-cut Rochelle salt crystals. The crystals were irradiated in the ferroelectric phase, and the measurements were made at room temperature several weeks or months after irradiation. The total number of Barkhausen jumps decreased rapidly with increasing dose for both materials. The starting field for Barkhausen jumps increased with increasing dose. The field distribution of Barkhausen jumps as measured by the commutation method showed a single maximum; as the dose was increased this maximum broadened and shifted to higher fields. These effects are ascribed to stabilization of the domain structure by the γ irradiation. When the field distribution of Barkhausen jumps is measured with a stepwise-varying field, the maximum occurs at the field for which the slope of the hysteresis loop is greatest, and if the hysteresis loop is distorted two maxima may be observed. Negative Barkhausen jumps were also observed. Gamma irradiation had an inhibiting effect on polarization jumps produced by mechanical stress. (TCO)

20175 SOME ELECTRONIC EFFECTS IN ROCHELLE SALT MONOCRYSTALS. Eisner, I. Ya. Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 2014-16(Nov. 1965). (In Russian).

The ir absorption, electric conductivity, and exoelectron emission of γ-irradiated X-cut Rochelle salt crystal plates were measured. The crystals were exposed to 2 to 4 MR at the rate of 0.45 MR/hr. The irradiation increased the ir absorption and produced a prominent absorption peak at 2.4 μ. The effects are ascribed to radiation defects; an impurity activation energy of 0.5 ev was determined from the peak. The measured variation of the electric resistance with time is shown for various temperatures of the unirradiated crystals and for crystals irradiated with given integral doses. A damping curve for exoelectron emission from irradiated specimens is given; no change of emission intensity under mechanical stress was found. (M.J.T.)

REACTOR TECHNOLOGY

General

Refer also to abstracts 18872 and 19222.

20176 (ANL–7110) REACTOR PHYSICS DIVISION ANNUAL REPORT, JULY 1, 1964–JUNE 30, 1965. (Argonne National Lab., Ill.). Dec. 1965. Contract W-31-109-eng-38. 422p. Dep. mn. CFSTI $7.22 cy, $2.00 mn.

Separate abstracts were prepared for the five sections of the report. (D.C.W.)

For abstracts of individual sections see: 19018, 19805, 20200, 20201, and 20229.

20177 (BNL–929, pp 83-105) NUCLEAR ENGINEERING. (Brookhaven National Lab., Upton, N. Y.).

Results of research on fundamentals of reactor physics, chemistry, and metallurgy are presented. Studies in the fields of reactor materials, liquid-metal heat transfer and containment, and direct conversion of heat to electricity are summarized. (J.R.D.)

20178 (STL–372-27) KINETIC STUDIES OF HETEROGENEOUS WATER REACTORS. Quarterly Progress Report for Period Ending September 30, 1965. Neal, L. G.; Wentz, L. B.; Zivi, S. M. (TRW Systems, Redondo Beach, Calif. Applied Thermodynamics Dept.). Oct. 30, 1965. Contract AT(04-3)-372. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Separate abstracts were prepared for the 3 included sections. (M.O.W.)

For abstracts of individual sections see: 18872, 20179, and 20180.

20179 (STL–372-27, pp 3-12) IN-PILE CAPSULE MEASUREMENTS OF TRANSIENT STEAM-VOID FORMATION. Wentz, L. B. (TRW Systems, Redondo Beach, Calif. Applied Thermodynamics Dept.).

Recent progress in the in-pile capsule measurements of rapid transient steam void formation is presented. Consistency and piston inertial loading dependence data were collected for one disc. Initial exploratory runs were made at an elevated initial capsule pressure. The results of the tests indicate that the magnitude of the initial pressure peak varies approximately as the cube root of piston loading; that the pressure drops to about zero psig between pressure pulses in the pressurized runs; and that the initial pressure impulse is about twice as large for runs pressurized to 100 psig as for atmospheric runs. (M.O.W.)

20180 (STL–372-27, pp 22-35) HEAT CONDUCTION CRITERION FOR DISPERSAL OF MOLTEN REACTOR FUEL BY TRANSIENT BOILING OF COOLANT. Zivi, S. M. (TRW Systems, Redondo Beach, Calif. Applied Thermodynamics Dept.).

For fuel-coolant combinations which are relatively unreactive chemically, it is hypothesized that rapid boiling of the coolant at the molten fuel interface is the primary mechanism of fuel dispersal. Therefore, if the fuel surface temperature is depressed below the boiling point by ordinary heat conduction into the coolant, no dispersal is expected to occur. Examples of typical fuels and claddings in water are discussed. (M.O.W.)

20181 (AEC-tr–6644) NUCLEAR REACTORS FOR 1964. CHAPTER V. COMMISSARIAT A L'ENERGIE ATOMIQUE, ANNUAL REPORT 1964. Translation of pp 103-28, Chapter V, from Commissariat a l'Energie Atomique Rapport Annuel, 1964. 30p. Dep. mn. JCL $2.60 fs, $1.10 mf.

Brief discussions are presented on the operations of various French research, testing, experimental, and production reactors. Several critical assemblies are also discussed. (M.O.W.)

20182 (AEC-tr–6700) ATOMS FOR PEACE. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR). Translation of Atom Miru, Atomizdat, Moscow, 1965. 66p. Dep. mn. CFSTI $3.00 cy, $0.75. JCL $6.60 fs, $2.18 mf.

A survey on the development and uses of atomic energy in the Soviet Union is presented. Nuclear power plants, thermonuclear research, and uses of radiations and radioisotopes are discussed. (D.C.W.)

20183 REACTOR DEVELOPMENT AND TECHNOLOGY. pp 3-101 of Fundamental Nuclear Energy Research, Washington, D. C., U. S. Atomic Energy Commission, 1965.

Research is summarized concerning reactor fuels and materials, reactor physics, reactor instrumentation and heat exchange, processing for recovery of fissionable materials from spent fuels, breeder reactors, and nuclear safety. (J.R.D.)

Auxiliaries and Components

Refer also to abstract 18864.

20184 (ACNP–65579) CONCEPTUAL DESIGN OF LARGE SODIUM VALVES. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). Mar. 1966. Contract AT(11-1)-1357. 93p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The valve requirements for large (1000 Mw(e)) sodium-cooled fast reactor plants, past and present sodium valve technology, and new sodium valve concepts are described. The new conceptual valve designs were developed for use in in a large fast reactor plant. The valve concepts include many features designed to prevent the recurrence of problems which have been encountered with most valves used for sodium service. Cost estimates are presented for the valves selected. (auth)

20185 (CONF-650204–9) THERMOCOUPLE RESEARCH AT GE-NMPO. Kuhlman, William C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Feb. 10, 1965. Contract AT(40-1)-2847. 29p. (GE-TM–65-2-15). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Meeting on Thermocouple Technology and the Effects of Nuclear Radiation on Thermocouples, Washington, D. C.

Insulation tests were made on thermocouples to be used in reactors. Results of the tests are presented for BeO, ThO_2, and HfO_2. In addition, in-pile transmutation tests were made on thermocouples of W/W-25Re. The thermoelectric properties of W–Os, Re–Os, and W–Tc alloys were investigated. Detailed results are presented. (M.O.W.)

20186 (DP–834) DEVELOPMENT OF A TEMPERATURE MONITOR FOR LARGE REACTORS. Dexter, Arthur H.; Hutter, Carl R.; Goosey, Malcolm H.; Leep, Richard W.; Wilson, John N. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Mar. 1966. Contract AT(07-2)-1. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A temperature monitor was designed to measure the temperature rise of coolant flowing through each fuel channel of a nuclear reactor. Although the monitor was intended for use with a large heavy water-cooled reactor, the design principles are generally applicable to large power and production reactors that employ forced flow of coolant. A scanning monitor was chosen because it has more economic and operational advantages than a continuous monitor. Digital circuitry permits automatic programming, arithmetic operations, and visual displays. Arguments are presented for types of alarms which should be provided. (auth)

20187 (EURAEC–1361) A STUDY OF THE APPLICATION OF ACOUSTICAL METHODS FOR DETERMINING VOID FRACTIONS IN BOILING WATER SYSTEMS. Walle, F. v. d.; Verheugen (Technische Hogeschool, Eindhoven (Netherlands)); Haagh, V. J. M. (Rescona N. V., Amstelveen (Netherlands)); Bogaardt, M. (Technische Hogeschool, Eindhoven (Netherlands)). Feb. 1966. 26p. (EUR–2336.e; CONF-650670–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Symposium on Two-Phase Flow, Exeter, Eng.

A survey was made of the acoustical properties of liquid gas-bubble mixtures. The available theory was extended to the case of liquid vapor-bubble mixtures. Expressions for speed of sound and damping were derived and numerical values were calculated. It is shown that it is possible in principle to determine volume fraction of vapor and bubble size distribution from measurements of speed of sound and damping in a mixture as a function of frequency. The method is especially for small void ratios. Some simple experiments were started in an air-water mixture. (auth)

20188 (IITRI–578P21-17) STUDIES OF REACTOR CONTAINMENT. Progress Report, December 1965–January 1966. Eichler, J. B.; Gallagher, E. V.; Lieberman, P. (comps.) (IIT Research Inst., Chicago, Ill.). Contract AT(11-1)-578. 17p. (IITRI–T6042-17). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work done during this period is reported on the following three tasks; crushable shield analysis and design, shock impingement experiments on crushable shields, and coolant decompression experiments and analysis. Brief comments are given for each. (M.O.W.)

20189 (R64CAP10) HEAT TRANSFER FAILURE MECHANISMS IN SIMULATED ORGANIC-COOLED FUEL BUNDLES. Rogers, J. T. (Canadian General Electric Co., Ltd., Peterborough (Ontario). Civilian Atomic Power Dept.). May 1965. 88p. Dep. mn.

Experiments in two-element test sections with HB-40 and with Santowax OM plus 30% high boilers show that the heat transfer mechanism may be either true, localized DNB or coke-out. The coke-out phenomenon is explained and conditions for its occurrence are examined. The adequacy of the WR-1 fuel design failure criterion is shown. (auth)

20190 (RT/FI–(65)52) EVALUATION OF THE TEMPERATURE DISTRIBUTION IN THE FUEL UNDER TRANSIENT CONDITIONS OF POWER. Buffoni, G.; Galati, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 18p. Dep. mn.

Expansions in series are applied to the mathematical problem of temperature distribution in the fuel under transient conditions of power. The cells taken into consideration are monodimensional and their configuration can be a slab, a cylinder, or a sphere. The heat source is considered as a known function of space and time. Some elementary numerical examples are given. The mathematical framework of a FORTRAN program for the IBM 7094 is described. (auth)

20191 EMERGENCY COOLING INSTALLATIONS OF HIGH-TEMPERATURE REACTORS. Schoening, J.; Helfrich, F. (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirtschaft, 11: 133-8(Mar. 1966). (In German).

The emergency cooler is a safety device that begins operation in the event of the failure of a reactor or an evaporator. The functions of the cooler are: the condensation of the steam, cooling of the gases, and capture and storage of the gases and condensates. The design, model studies, and construction of a mixed cooler are illustrated on the basis of an emergency cooling device designed for the high-temperature reactor in Juelich. The studies showed that the mixed cooler is adequately dimensioned and fulfils its function as an emergency cooling device. (tr-auth)

20192 PLUG FOR THE TANK BOTTOMS OF ATOMIC PILES. Gerard, Victor J.; Martin, Jean A. (to Societe Anonyme Groupement Atomique Alsacienne Atlantique). Canadian Patent 725,278. Jan. 4, 1966.

A hollow aluminum plug with suitable flanges and tapered portions having a clearance of the order of 10^{-2} mm is shaped to close a hole in the reactor calandria base. Inside is a spring, also of aluminum whose ends project horizontally to lock the plug in calandria hole. For insertion and withdrawal, a pin operated by remotely controlled tongs actuates the spring so that the ends may be locked in place in the reactor bottom or released for removal. (F.S.A.)

20193 CONTROL ROD DRIVE MECHANISM. Komai, Kenichiro (to Hitachi, Ltd.). Japanese Patent 1964-3076. Feb. 17, 1965. Filed Feb. 12, 1962.

A relatively small, simple device is proposed for driving a control rod vertically The rod of a motor which rotates; a rod, connecting to this rod with a pinion at the other end; and a fixed vertical rod that is not rotatable are all attached with a plate at their one end. Thus, the two rotating rods are connected to each other through the two plates. Normally, the two plates are attracted together by means of magnetic coils so that the rotating motion of a motor rod is transmitted directly to the latter rod having a pinion. By the pinion and rack system, a control rod can be driven up and down to hold the control rod not movable at a desired position, the plate of a pinion rod is attracted magnetically to the plate of a fixed rod. Thus, when the connection with the plate of a motor rod is severed, the rod cannot rotate. An electric-current adjuster is installed in an electric circuit to each pair of magnetic coils. (NSA of Japan)

20194 BUFFER EQUIPMENT FOR A REACTOR CONTROL ROD. Maehara, Tatsuichi (Mitsubishi Atomic Power Industry, Inc.). Japanese Patent 1964-3077. Feb. 17, 1965. Filed Dec. 19, 1962.

In the proposed buffer equipment for reducing the shock when a control rod is dropped, a number of holes are made through the wall of a cylinder, and the resistance of a fluid flowing through these holes is employed. Using this equipment, the velocity of a control rod is brought to almost zero when it hits, i.e., at the end of the buffer action. (TCO)

Criticality Studies

Refer also to abstracts 19784 and 20310.

20195 (AAEC/TM–302) ANISOTROPY IN THE MIGRATION AREA IN A PARALLEL SLAB SUBCRITICAL ASSEMBLY. Keane, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov. 1965. 6p. Dep. mn.

A correction is derived for the anisotropy in the migration area in a subcritical assembly consisting of thick slabs of moderator interspersed with thin layers of fuel. (auth)

20196 (AEEW-M–581) REACTOR PERTURBATION CALCULATIONS BY MONTE CARLO METHODS. Gubbins, M. E. (Atomic Energy Establishment, Winfrith (England)). Sept. 1965. 24p. Dep. BIS $0.80. HMSO 4s.

While Monte Carlo methods are useful for reactor calculations involving complicated geometry, it is difficult to apply them to the calculation of perturbation worths because of the large amount of computing time needed to obtain good accuracy. Various ways of overcoming these difficulties were investigated with the problem of estimating absorbing control rod worths particularly in mind. As a basis for discussion a method of carrying out multigroup reactor calculations by Monte Carlo methods is described. Two methods of estimating a perturbation worth directly, without differencing two quantities of like magnitude, are examined closely but are passed over in favor of a third method based on a correlation technique. This correlation method is described, and demonstrated by a limited range of calculations for absorbing control rods in a fast reactor. In these calculations control rod worths of between 1% amd 7% in reactivity are estimated to an accuracy better than 10% (3 standard errors) in about one hour's computing

time on the English Electric KDF.9 digital computer. (auth)

20197 (AEEW-R-438) BUCKLING AND REACTION RATE MEASUREMENTS IN GRAPHITE MODERATED LATTICES FUELLED WITH PLUTONIUM–URANIUM OXIDE CLUSTERS AT TEMPERATURES UP TO 400 DEG C. Carter, D. H.; Gibson, M.; King, D. C.; Marshall, J.; Puckett, B. J.; Richards, A. E.; Wass, T.; Wilson, D. J. (Atomic Energy Establishment, Winfrith (England)). July 1965. 147p. Dep. BIS $4.00. HMSO 20s.0d.

A series of experiments carried out in SCORPIO I and II on sub-critical graphite moderated lattices fueled with 21-rod clusters of PuO_2/UO_2 fuel are described. Three fuel batches with nominal plutonium: uranium ratios of 0.25%, 0.8% and 1.2% were investigated at temperatures between 20°C and 400°C. Because of the limited amounts of the three fuels, exponential measurements were made in 2-zone stacks, the outer regions of which were loaded with suitably matched "reference fuel." Fine structure distributions in the lattice cell were obtained with manganese and indium foils. $^{239}Pu/^{235}U$ fission ratios were determined both by fission chambers and by fission-product counting techniques. (auth)

20198 (AEEW-R-464) FURTHER BUCKLING MEASUREMENTS ON A HEATED GRAPHITE LATTICE FUELLED WITH 0.8 PERCENT PuO_2/UO_2 CLUSTERS. Wilson, D. J. (Atomic Energy Establishment, Winfrith (England)). Oct. 1965. 26p. Dep. BIS $0.90. HMSO 4s. 6d.

The buckling of a graphite moderated stack fueled with 0.8% PuO_2/UO_2 21 rod clusters in a 14" lattice pitch was measured by the exponential method. The stack was built in the SCORPIO I facility which enabled the experiments to be made at 200 and 390°C as well as at ambient temperature. The experimental results are shown to be in very satisfactory agreement with predictions using the ARGOSY IV method. (auth)

20199 (AEEW-R-466) A COMPARISON OF MEASUREMENTS ON PuO_2–UO_2 FUELLED GRAPHITE LATTICES WITH CALCULATIONS USING THE ARGOSY METHOD. King, D. C. (Atomic Energy Establishment, Winfrith (England)). Jan. 1966. 48p. Dep. BIS $1.40. HMSO 7s.

The predictions of the ARGOSY method of calculation are compared with buckling and reaction rate measurements on graphite lattices containing plutonium enriched oxide cluster fuels. Most of the measurements were obtained on one lattice pitch giving a graphite-to-fuel volume ratio similar to that in the Windscale A.G.R. Apart from a reduction of 10% in the values of the capture and fission resonance integrals (4 ev to 10 kev) of all nuclides the method as coded in ARGOSY III uses basic nuclear data. It is shown that the buckling predictions of ARGOSY III at room temperature are in agreement with the experimentally determined values within approximately the experimental error, i.e., equivalent to ±0.5% in reactivity. When systematic errors are removed, however, a linear trend with the fraction of fissions occurring in ^{239}Pu is evident; the calculated reactivity being (0.6 ± 0.3)% high for fuel with 80% of fission occurring in ^{239}Pu. The experimentally determined change of buckling between 20 and 390°C is predicted to within the experimental error, i.e., equivalent to ±0.7 mn/°C. Reaction rate ratios and radial power distributions at all temperatures are predicted well by ARGOSY III. (auth)

20200 (ANL–7110, pp 29–98) THERMAL REACTORS. (Argonne National Lab., Ill.).

The relation between the Cd ratio and the core moderating ratio was investigated, and the investigation of slow neutron spectra by neutron activation was studied. Measurements of small reactivities were made in the Argonne Thermal Source Reactor; and physics analyses, safety studies, and critical-facility loading studies were performed for the Argonne Advanced Research Reactor. Oscillations in a natural-circulation boiling-water loop were studied, as well as the space-dependent dynamics of boiling reactors. The physics of slightly enriched, water-moderated uranium dioxide lattices were also investigated in connection with the High Conversion Critical Experiment Program. In connection with the EBWR Plutonium Recycle experimental program, an evaluation of cross sections for heavy elements was made, and methods of determining the capture-to-fission ratios for ^{239}Pu and ^{241}Pu were studied. (D.C.W.)

20201 (ANL–7110, pp 311–401) MISCELLANEOUS. (Argonne National Lab., Ill.).

Efforts were made to extend and improve the accuracy of general reactor physics, with emphasis on resonance absorption and scattering effects. Codes and methods for reactor physics calculations were developed, together with methods for evaluating mathematical functions. A rotating electric power generation system was evaluated, and the efficiency of nuclear pumping of a laser was studied, along with the amplification of gamma photons by nuclear pumping. Thermionic energy conversion with a plasma thermocouple was investigated, as was the vaporization of sodium in coolant channels. The effects of the thermal properties of UO_2 on the dynamics of fast reactors were studied, and methods were developed for determining the stress distributions in fuel elements. The thermophysical properties of reactor materials at high temperatures were also studied. (D.C.W.)

20202 (AWRE-O-4/66) RSKF—A REACTOR KINETICS CODE FOR THE IBM 7030. Brickstock, A.; Davies, A. R. (Atomic Weapons Research Establishment, Aldermaston (England)). Feb. 1966. 28p. Dep. mn. BIS $0.80. HSMO 4s. 0d.

RSKF is a versatile code which will solve a large variety of one group space independent reactor kinetic problems, including up to 20 groups of delayed neutrons. Response to a variety of different types of reactivity variation may be followed and various shutdown mechanisms may be initiated by specific power level or period trips. The integration is fast and completely automatic in the sense that the integrating interval is computed by the code at every time step. (M.O.W.)

20203 (EUR–2751.e) FIRST FLIGHT COLLISION PROBABILITIES IN PIN CLUSTERS AND ROD LATTICES. Amyot, L.; Benoist, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb. 1966. 24p. Dep. mn.

A method of calculating directional probabilities of interaction in pin clusters and rod lattices is described. The theory has been programmed for the IBM 7090 as the computer code PROCOPE. Results for Dancoff correction factors and collision probabilities are compared with values obtained using other methods. The validity of the technique is also checked by evaluating the fine structure of the thermal flux distributions in various gas-cooled clusters upon which measurements have been made at Saclay. As a practical illustration, a series of curves describe the behavior of the various independent fuel-to-fuel collision probabilities in 19 (or 7) pin gas-cooled clusters. Finally, approximate formulas are given for the pin-to-pin collision probability at both the white and the black limits. (auth)

20204 (INR–656/IX-A/R) MEASUREMENT OF NEUTRON DENSITY DISTRIBUTIONS IN MULTILAYER UNIT CELLS. I. THE METHOD. Adamski, L.; Jozefowicz, E. T.; Jozefowicz, K.; Szechter, A. (Institute of Nuclear Research, Warsaw (Poland)). Sept. 1965. 19p. Dep.

The method of intracell neutron density distribution measurements using a new type of detector is described. The detector consists of a copper wire spiral wound tightly on a sandwich simulating the layers of a reactor elementary cell. After irradiation in the cell of lattice studied, the spiral is cut into single coils and their activity is measured using a conventional method. The intercomparison with other methods, experimental analysis of errors, as well as the general evaluation of the method is presented. (auth)

20205 (JAERI–1097) CODE GRAFA—AN IBM-7044 FORTRAN IV CODE FOR CALCULATION OF THE NEUTRON SPECTRUM FOR SQUARE AND HEXAGONAL LATTICES. **Takahashi, Hiroshi; Nakayama, Takashi; Tsutsui, Tsuneo (Japan Atomic Energy Research Inst., Tokyo).** Nov. 1965. 18p. Dep. mn.

A description is presented of the GRAFA code written in FORTRAN IV for the IBM 7044. The code computes the scalar thermal neutron spectrum as a function of spatial regions in a square and hexagonal lattice by using the first flight collision probabilities for these geometries. The scattering kernel data calculated by various models are input from the library tape. (auth)

20206 (NAA-SR–11356) NEUTRON FLUX MONITORING WITH ARGON GAS. A Final Report. **Smith, C. R. F.; Saur, A. J. (Atomics International, Canoga Park, Calif.).** Mar. 25, 1966. Contract AT(11-1)-Gen-8. 135p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

A flowing stream of argon gas was used to monitor neutron flux in nuclear reactors over the ranges 27 to 380°C simulated in-core temperature and 1 w to 1 Mw reactor power. The system consisted of small bore inlet and outlet tubes, leading to and from an in-core activation chamber where the reaction, $^{40}Ar(n,\gamma)^{41}Ar$, primarily took place. ^{41}Ar in the effluent stream was directed through a NaI(Tl) scintillator crystal which measured the rate of decay of ^{41}Ar by (β,γ) emission to nonradioactive ^{41}K. A number of equations were derived, whereby neutron flux could be computed from various system parameters. The variables among these parameters were: pressures at the inlet and outlet tubes and at the in-core chamber, temperatures at the same locations, mass flowrate, countrate, and an efficiency factor for the crystal. Various configurations of gas handling systems were tested. It was found that, at constant reactor power, computed neutron flux could be held within 5% over the temperature range cited above. It was also shown that computed neutron flux was virtually linear with reactor power over the six decades of power. A modified system is described, whereby neutron flux (as indicated by the scintillator countrate alone) could be made virtually insensitive to reactor temperatures (to within about 5%) over a range of 277 to 702°C. Finally, it is suggested that, in spite of a greatly reduced absorption cross section for argon, this system would be able to monitor neutron flux, in core and continuously, in fast-flux nuclear power reactors. (auth)

20207 (ORNL–TM–1302) REACTOR DEPLETION CODE ASSAULT (TWO-DIMENSIONAL, MULTI-NEUTRON-GROUP, DIFFUSION). **Vondy, D. R.; Fowler, T. B.; Tobias, M. L. (Oak Ridge National Lab., Tenn.).** Mar. 1966. Contract W-7405-eng-26. 83p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Given nuclide concentrations and microscopic cross sections, ASSAULT solves the multi-region, multi-group neutron diffusion equations in one or two dimensions in rectangular (X-Y) or cylindrical (R-Z or R-θ) geometry. The calculated neutron reaction rates are then used to determine nuclide concentrations after a specified period of exposure. These calculations are repeated for a specified number of time steps. Criticality may be satisfied by direct group and region dependent poison search, indirect fuel or moderator search, or specified material interchanges. Material may be recycled and several cycles may be considered. A discount method of fuel cycle cost is included. Nuclide chains are specified by input with provision to consider interlocked chains, partial capture routes, and high energy (n,2n) product routes. Input data requirements, operation, and applications are discussed. (auth)

20208 (RT/FI–(65)51) HARBOR, UN CODICE AD UNA DIMENSIONE E DUE GRUPPI PER IL CALCOLO DI UN REATTORE AD ACQUA BOLLENTE. (HARBOR—A One-Dimension Two-Group Code for Boiling Water Reactor Calculations). **Galati, A.; Loizzo, P.; Pepino, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)).** Nov. 1965. 38p. Dep. mn.

A model is described for survey and first approximation calculations of the operation features of a boiling water reactor. The convergency of the iterative process flux-voids for the calculation of the axial power distribution is discussed. The code input options and a sample problem are given. (auth)

20209 (TID–22730) THE DETERMINATION OF EFFECTIVE DELAYED NEUTRON AND PHOTONEUTRON KINETICS PARAMETERS IN A HIGHLY ENRICHED HEAVY-WATER REACTOR [Thesis]. **Graham III, W. W.; Harmer, D. S. (Georgia Inst. of Tech., Atlanta. School of Nuclear Engineering).** Aug. 1965. Contract AT(38-1)-403. 179p. (NE–3). Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Effective values of the delayed neutron and photoneutron relative abundances, $\beta_i eff/\Sigma_i \beta_i eff$, and the decay constants, λ_i, which are applicable to a highly enriched heavy-water reactor were determined experimentally. These parameters are required for precise calculations of the kinetic behavior of the reactor. Neutron flux decay data following a rod drop in the Georgia Tech Research Reactor were collected over periods in excess of three days. The reactor had not operated above 200 watts; most of its operation had been at 1 watt. Scintillation and fission chamber detection systems were used. The data have been fitted to the expression $n(t_j \rightarrow t_j + \Delta t_j) = \Sigma_{i=1}^{M} \int_{t_j}^{t_j+\Delta t_j} a_i' e^{-\lambda_i' t} dt$ by the weighted least-squares criterion, using the Variable Metric Minimization method. Corrections were made in order to account for delayed neutron precursor concentrations at the time of the rod drop, the finite time required to drop the rods, and for post-drop sub-critical neutron multiplication. Various values of M, the total number of groups permitted in the summation, were tried, and the best fit was found for M = 13. One of the thirteen groups is attributed to background. Thus, twelve delayed neutron groups are indicated for the Georgia Tech Research Reactor. Comparisons are made with previously obtained values of relative group abundances and decay constants available in the literature. (auth)

20210 (WCAP–3269-39) CRITICAL EXPERIMENTS PERFORMED WITH CLUSTERED AND UNIFORM ARRAYS OF RODDED ABSORBERS. **Leamer, R. D.; Hanlen, D. F.; Hamilton, G. N.; Taylor, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).** Nov. 1965. Contract AT(30-1)-3269. 110p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

A series of critical experiments was undertaken in which the reactivity worths of clusters and uniform arrays of Ag–In–Cd absorber rods were measured in water-moderated uranium-oxide cores of low enrichment. Experimental parameters included enrichment, lattice pitch, diameter of poison and fuel rods, and absorber rod cladding thickness. Reactivity worths were obtained by measuring the critical water heights of the test and reference cases, and integrating the differential water worth curve between those limits. Some of the experiments had very small worths (e.g., absorber rod cladding), so good core reproducibility was required. These experiments were performed using a variety of fuel including stainless steel clad fuel rods of 2.7 wt %, 3.7 wt %, and 5.7 wt % enrichments, and Zircaloy-4 clad rods of 2.72 wt % enrichment. (M.O.W.)

20211 (ZfK-TPh–17) BERICHT UEBER DEN STAND DER REAKTORCODES DER ABTEILUNG REAKTORTHEORIE DES ZfK. (Report on the Position of Reactor Codes of the Reactor Theory Division of the ZfK). **Reiche, Christian (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)).** Apr. 1965. 57p. Dep. mn.

The mathematical and physical bases of the PROZZOR program for the calculation of critical data for spherical two-zone fast reactors, the PRIDCO program for the solution of one-dimensional multigroup diffusion problems, and the AZZOR program for the calculation of the long-term behavior of two-zone fast reactors are presented. The limitations of the programs are discussed. (D.C.W.)

20212 TRANSFER FUNCTION AND POWER SPECTRAL DENSITY IN A ZERO POWER REACTOR. Saito, Keiichi (Japan Atomic Energy Research Inst., Tokyo); Otsuka, Masuhiko. J. Nucl. Sci. Technol., 3: 45-50 (Feb. 1966).

For a zero-power reactor, a new approach is proposed for extending the frequency response obtained by pile modulation experiment to account for dependency in space and energy, and the result is compared with the power spectral density of reactor noise. While in a point reactor model, the square modulus of the reactor transfer function and the power spectral density are proportional to each other, this relation is no longer applicable to the generalized case. Some quantitative discussions are made in this regard for the particular case of a bare homogeneous reactor with mono-energetic neutrons. (auth)

20213 DIRECT MEASUREMENT OF NEUTRON FLUX. Fujiie, Yoichi (Hitachi Zosen, Ltd., Osaka); Suita, Tokuo. J. Nucl. Sci. Technol., 3: 83-4(Feb. 1966).

A method of neutron flux measurement based on fission product flight over electrodes is presented. Typical experimental results are presented. (L.B.S.)

20214 ON THE DETERMINATION OF MICROSCOPIC REACTOR PARAMETERS USING AN EXPONENTIAL ASSEMBLY. I. Kleijn, H. R. (Reactor Instituut, Delft, Netherlands). Koninkl. Ned. Akad. Wetensch., Proc., Ser. B, 69: 111-21(1966).

An exponential assembly employing an external neutron source is discussed. Experimental techniques and calculation methods of microscopic reactor parameters using an exponential assembly are presented. (B.G.D.)

20215 ON THE DETERMINATION OF MICROSCOPIC REACTOR PARAMETERS USING AN EXPONENTIAL ASSEMBLY. II. Kleijn, H. R. (Reactor Instituut, Delft, Netherlands). Koninkl. Ned. Akad. Wetensch., Proc., Ser. B, 69: 122-34(1966).

The design and physical characteristics of the light water exponential assembly (LEAD) are discussed. The exponential assembly using the swimming pool reactor Hor as a neutron source in determining microscopic reactor parameters is presented. (B.G.D.)

20216 ON THE DETERMINATION OF MICROSCOPIC REACTOR PARAMETERS USING AN EXPONENTIAL ASSEMBLY. III. Kleijn, H. R. (Reactor Instituut, Delft, Netherlands). Koninkl. Ned. Akad. Wetensch., Proc., Ser. B, 69: 135-46(1966).

The use of the exponential assembly (LEAD) for determining microscopic reactor parameters under the simulation of operational conditions is discussed. The boiling effect (bubbles) and the influence of the presence of steam on the diffusion of neutrons are simulated under room temperature conditions. (B.G.D.)

20217 AUTOMATIC OPTIMIZATION OF THE MULTIPLICATION FACTOR K_∞ IN A NATURAL URANIUM–GRAPHITE TYPE REACTOR. Stefanescu, Al.; Stancu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 17: 867-73(1965). (In Rumanian).

In order to verify the rate of convergence of computerized optimization methods, a relatively well known function, the infinite neutron multiplication factor K_∞ of a Calder Hall type natural uranium–graphite reactor was examined. The problem involved determination of the optimum values of a (radius of the fuel rod) $0.5 \text{ cm} < a < 1.7 \text{ cm}$ and b (radius of the equivalent cell) $5 \text{ cm} < b < 15 \text{ cm}$. The heat removal zone was taken as 1 cm and the thickness of the Al cladding was assumed to be 0.115 cm. The value of K_∞ was obtained from the diffusion theory. It was found that the automatic optimization process reduced the time needed for deriving the best values by a factor of about 10000 as compared with calculations based on the tabulation of the function. (TTT)

Design and Feasibility

20218 (WAPD-T-1823) NUCLEAR DATA EVALUATION AT BETTIS ATOMIC POWER LABORATORY. Harris, D. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). June 1965. Contract AT(11-1)-Gen-14. 5p. (CONF-650576-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Nuclear Data Evaluation Conference, Upton, N. Y.

A brief summary of the nuclear data evaluations being carried out at the Bettis Atomic Power Laboratory for reactor design considerations is presented. (M.O.W.)

20219 DESIGN FEATURES OF THE MODERN PRESSURIZED WATER REACTOR. Abbott, W. E.; Beckjord, E. S.; Farbman, G. H. (Westinghouse Electric Corp., Pittsburgh). Proc. Amer. Power Conf., 27: 248-60(1965).

The status of the pressurized water reactor is outlined. The development of reactor and power-plant components is summarized. (D.C.W.)

Fuels

20220 (ORNL-TM-1358) NUFTIC—AN INFORMATION CENTER ON NUCLEAR FUEL TECHNOLOGY. Pilloton, R. L. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 35p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The amount of literature on the fabrication, evaluation, application, and economics of nuclear fuels is increasing rapidly. To cope with the difficulty of keeping informed, the Metals and Ceramics Division of the Oak Ridge National Laboratory has organized the Nuclear Fuel Technology Information Center (NUFTIC). In this center active scientists and engineers review the literature. A computer stores, searches, and prints information. The choice of information processing system, the method of operation of the center, and examples of the output are described. (auth)

20221 BEHAVIOR OF CLADDING TUBE UNDER COOLANT-LOSS ACCIDENT CONDITIONS. Mishima, Yoshitsugu (Tokyo Univ.); Aoki, Toshimasa; Ito, Goro; Kiyooka, Shoichi; Ono, Kenji; Seki, Yoshitatsu; Sumitomo, Motoo; Takao, Zenichiro. J. Nucl. Sci. Technol., 3: 72-82(Feb. 1966).

The behavior of cladding tubes, both stainless steel and Zircaloy under the post-accidental conditions of coolant loss is discussed, based on the results of three experiments performed this time. The effect of oxidation in post-accidental steam atmosphere up to temperatures where the cladding tube should burst with the pressure of entrapped fission product gas was found to be negligible. The bursting behavior of tubes containing pre-determined amounts of inert gas corresponding to the amounts of released fission product gas that should be present in various states of fuel usage was also examined. No effect of corrosion in Zircaloy-2 that should affect its strength could be found up to a weight gain corresponding to several years of use under normal operating conditions, either in the burst strength or creep burst behavior. (auth)

20222 FISSION GAS BEHAVIOR IN THE PARTICLE STRUCTURE OF A NUCLEAR FUEL PASTE. PART I. CONFIGURATION OF THE BUBBLES. Ziegenbein, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 671-8(Dec. 1965). (In German).

The gas behavior is studied as a function of the contact angle θ in a three-phase system (paste). It is pointed out that the gas gives no effect of forces on the particles when the amount of gas is small in relation to the amount of liquid for $\theta < 90°$, while attractive forces are present between the particles in the case of $\theta > 90°$. In the case of high amounts of gas, repulsive forces always act. (auth)

20223 NUCLEAR REACTOR FUEL. Crowther, Russell L. (to General Electric Co.). Canadian Patent 723,262. Dec. 7, 1965.

For a pressurized boiling light water reactor heterogeneous fuel elements using ^{238}U and ^{232}Th are described. The fuel is designed for fission in a non-uniform neutron flux. Various arrangements of the two fuel materials are used to achieve maximum power density and output. (F.S.A.)

20224 REACTOR FUEL ELEMENT WITH A HIGH POWER DENSITY. Kikuchi, Seishi (to Japan Atomic Energy Research Inst.). Japanese Patent 1964-3877. Mar. 1, 1965. Filed Sept. 21, 1962.

A fuel element with a high power density, consists of a nuclear-fuel foil of suitable thickness attached to a plate or cylindrical body made of a heat-resistant material such as graphite or beryllium oxide and another heat-resistant and impermeable material such as graphite, carbide, or other ceramic attached to the fuel foil. (TCO)

Power and Power-Breeder Reactors

Refer also to abstracts 18626 and 20290.

20225 (AECL-2525) CANDU BOOSTER ROD EXPERIMENT IN ZED-2. Kay, R. E.; Green, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1965. 27p. Dep. mn. AECL $1.00.

Experiments were performed in a simulated CANDU core in ZED-2 to determine the perturbing effect of a CANDU booster assembly on the surrounding lattice, the neutron distribution within the booster and its reactivity effect. The maximum observed flux perturbation in the lattice was ~ +25% at a distance of ~20 cm from the booster while the maximum perturbation in the booster was −43% at the center of the middle fuel plate. A calculation was performed, using a simplified model based on the ZED-2 measurements, to estimate the reactivity effect on the booster in CANDU. (auth)

20226 (AEEW-R-260) SALAMANDER—A FORTRAN PROGRAM FOR REACTOR FUEL CYCLE CALCULATIONS. Brinkworth, M. J.; Reith, J. (Atomic Energy Establishment, Winfrith (England)). Sept. 1965. 20p. Dep. BIS $0.70. HMSO 3s. 6d.

SALAMANDER is a Fortran program which performs reactor fuel cycle calculations in 20 or few energy groups for a homogenized core on a uniform flux model. Fuel costs are calculated by a new method. (auth)

20227 (AGN-TM-412) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. ML-1A SHIELD OPTIMIZATION STUDY. (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1965. Contract AT(10-1)-880. 102p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Several external shield concepts were evaluated to select the design which involved the least compromise to plant shipping weight and startup time while retaining the maximum flexibility for maintenance activities. The optimum shielding arrangement to satisfy the dose rate criteria specified for this study appears to consist of the following: modification of the reactor skid internal radial shield to the 3 in. tungsten-lead concept, modification of the reactor skid internal axial shield to the conical, reduced height concept, provision of a self-supporting membrane-type external water shield 44 in. thick, and use of 1.5 ft of sandbag expedient shielding to reduce the dose levels to 4 mRem/hr at 100 ft during reactor operation. The above four possibilities are discussed in detail. (M.O.W.)

20228 (AI-Memo-8810(Rev.1)) CRITICALITY STUDY—FIVE PERCENT ^{235}U ENRICHED FUEL FABRICATION. Ketzlach, N. (Atomics International, Canoga Park, Calif.). Aug. 28, 1963. Contract AT(11-1)-Gen-8. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Nuclear safety criteria were determined for all process steps involved in the fabrication of 5.0 per cent ^{235}U enriched UC fuel rods. Criteria are also presented for the storage and processing of the feedstock and all intermediate forms of the fuel to the finished product. This includes criteria for the shipment of the assembled fuel rods. Criteria, presented for large batch sizes, are based on container geometry control. This allows for safe batch sizes of 60 kg uranium in a single melting and casting operation. Suggestions are made for ensuring safety in the event of crucible rupture accompanied by water flooding. Taking into account the neutron poisoning of the steel support tubes in the fuel loading retort, seventy-five rods are safe (75 percent of calculated critical independent of spacing between rods or the degree of water flooding). Where safety is not controlled by container geometry or double batching is possible, safe limits are based on 45 percent of critical under conditions of optimum water moderation and reflection. Recommendations for the design of a shipping container using foamglass as a packaging and neutron poison material are made. An array of such containers (with 16 rods/container) could not be made critical under any conditions of water flooding. The use of styrofoam, however, as used in earlier shipments would limit the maximum safe number of shipping boxes to seven. (auth)

20229 (ANL-7110, pp 99-229) FAST REACTORS. (Argonne National Lab., Ill.).

A number of experimental and theoretical studies of the physics of fast reactors, including rocket reactors, were carried out. Safety studies were also performed, and a set of programs was developed for criticality calculations. Several fuel systems were studied. (D.C.W.)

20230 (BNL-887) THE RANDOMLY PACKED SETTLED-BED FAST REACTOR CONCEPT [1000-MW(e) REACTOR DESIGN]. Green, L.; Levine, M. M. (eds.) (Brookhaven National Lab., Upton, N. Y.). June 1, 1965. Contract AT(30-2)-Gen-16. 56p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The design concepts of a 1000-Mw(e) settled-bed fast reactor are discussed in terms of the following: settled-bed physics, bed engineering, thermal and hydraulic characteristics, plant design, reactor, coolant systems, auxiliary systems, plant operations and procedures, and economics. (M.O.W.)

20231 (BNWL-SA-547) PHYSICS DESIGN ASPECTS OF PLUTONIUM RECYCLE. Dawson, F. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 28, 1966. Contract AT(45-1)-1830. 49p. (CONF-660308-3). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Nuclear Society, Plutonium Information Meeting, Washington, D. C.

The physics design aspects of plutonium utilization in thermal reactors are discussed in terms of the following; the basic data on plutonium, design analysis method evaluation, the effects of plutonium on reactivity coefficients, and plutonium burnup characteristics. (M.O.W.)

20232 (CEA-R-2847) LE CO_2 DE REFROIDISSEMENT DES REACTEURS G2/G3 (FUITES, ANALYSE, ACTIVITE). (The CO_2 for Cooling the G2/G3 Reactors (Leaks, Analysis, Activity)). Meiffren, Jose; Dupay, Francis (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Oct. 1965. 75p. Dep. mn.

The data obtained during five years operation of the reactor G2 and G3 at Marcoule as far as the cooling gas is concerned, from storage of reserves up to its slow escape into the atmosphere, and including all the stages of its practical use, its chemical examination, its nuclear behavior and its possible physicochemical transformation are included. (M.O.W.)

20233 (CEA-R-2870) LA RADIOPROTECTION DES TRAVAUX SUR LES ECHANGEURS DES PILES G.2 ET G.3. (Radioprotection During Work on the G2 and G3 Reactor Exchangers). Rodier, Jean; Chassany, Jean; Guillermin, Pierre (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Dec. 1965. 35p. Dep. mn.

During this work and its preparation, which took place first at G-2 and then at G-3 over a period of 11 months, 15,000 measurement results were obtained. Their analysis, together with a consideration of the organization on the site and of the conclusions drawn from the experiment, shows the various factors which determine the importance of the radioactive dangers. (auth)

20234 (CEND/PRWRA-257A) BOILING NUCLEAR SUPERHEATER (BONUS) POWER STATION: ABSTRACT OF STARTUP SUMMARY REPORT (CEND/PRWRA-257). (Combustion Engineering, Inc., Windsor, Conn. Puerto Rico Water Resources Authority, San Juan). Mar. 1966. Contracts AT(40-1)-2674; AT(40-1)-2672. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A summary of an earlier start-up report (CEND/PRWRA-257) is presented. Operating characteristics of the reactor are briefly described. (M.O.W.)

20235 (EUR-2521.e) METHOD OF CALCULATING FUEL CYCLE COST ON THE BASIS OF ACTUAL OPERATING DATA. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov. 1965. 33p. Dep. mn.

A method of calculating the fuel cycle costs for operating reactors is outlined. (D.C.W.)

20236 (EURAEC-1561) STABILITY STUDIES FOR BOILING-WATER REACTORS. Final Report No. 1, April 1, 1964-March 31, 1965. (Kernenergieanlagen, Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany)). Apr. 30, 1965. Contract 020-64-4TEED. 37p. (EUR-2700). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

An experimental method for calculating the stability of boiling water reactors is described. The test rig, test instrumentation, frequency response measurement, and the test procedure are described. In addition, corresponding theoretical work for comparison with experimental results is reported. (M.O.W.)

20237 (EURFNR-42F) LIQUID METAL REACTOR COOLING SYSTEMS. Aberdam, Myriam; Gros, Gilbert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translation of report CEA-Bib-49. Feb. 1965. 345p. Dep. mn. CFSTI $7.00 cy, $1.75 mn.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A survey of the principal liquid-metal-cooled reactors now in operation, under construction, or in the design stage is presented. The components of the cooling systems are described. 165 references. (D.C.W.)

20238 (GA-6829) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report, October 31, 1965. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Nov. 30, 1965. Contract AT(04-3)-314. 22p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Analyses were performed relating to the continuation of zero-power testing. A Fortran-IV code, GAPS, was written to permit rapid analysis of data from planned pulsed-neutron measurements of reactivity. Analyses of control rod worths and power distributions were made. Preliminary calculation of the excess reactivity, shutdown reactivity, and reactivity versus number of fuel elements were made for the as-built core. The dummy off-loader, which was mounted over the access nozzle to perform alignment adjustments, performed satisfactorily in a series of operability tests. Equipment for performing flux mapping measurements in the core during zero-power reactor operation has successfully undergone preliminary testing in the dummy core under conditions similar to those that will occur during actual flux measurements. Measurements were taken in the core to determine the optimum source location for initial fuel loading. A series of calculations was performed with the SSHB code to determine the maximum helium flow that will result in acceptable steam conditions at various power levels between 30% and full power during Test GP-1, "Power Coefficient Test with Constant Flow." (auth)

20239 (LA-3482) QUARTERLY STATUS REPORT ON ADVANCED REACTOR TECHNOLOGY (ART) FOR PERIOD ENDING JANUARY 31, 1966. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Feb. 1966. Contract W-7405-eng-36. 64p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Further developments in construction of the Fast Reactor Core Test Facility (FRCTF) are reported. Preliminary calculations for the Molten Plutonium Burnup Experiment (MPBE) are given. The corrosive effects of molten Pu alloys on Ta and Ta-W fuel capsules are presented. The results are also presented for carburized fuel capsules. Sodium technology and other supported research to be used in conjunction with the MPRE are included. (M.O.W.)

20240 (LA-DC-7739) STATUS OF FAST REACTOR PHYSICS DESIGN. Hannum, W. H. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 21p. (CONF-660308-2). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Nuclear Society, Plutonium Information Meeting, Washington, D. C.

The physics and nuclear design aspects of fast reactors are discussed. In particular, the discussions concern (1) the nuclear design (neutron balance, breeding potential, etc.), (2) safety, and (3) analysis and operation, including prediction of normal static and dynamic operating characteristics. (M.O.W.)

20241 (NYO-3122-35) SHUTDOWN REACTIVITY METER DEVELOPMENT. PHASE II. OPERATION IN HIGH GAMMA FIELDS. Bluestein, I.; Matty, T. C.; Schultz, M. A. (Milletron, Inc., Irwin, Pa.). Dec. 31, 1965. Contract AT(30-1)-3122. 109p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

Two approaches for using conventional neutron detectors and electronic apparatus for shutdown reactivity measurements on power reactors using noise measurement techniques are outlined. A narrow band system having the advantage of simplicity, but only moderate gamma rejection is described, as is a complex wide band multiple detector system having excellent theoretical neutron-to-gamma discrimination. The approach finally used is a narrow band one that employs a new multiple element detector. A complete shutdown reactivity monitoring system is presented and the results of preliminary tests using this system at the B. & W. Test Reactor are given. (auth)

20242 (NYO-3379-3) RECOMMENDATIONS FOR IMPROVEMENT OF THE PM-TYPE REACTOR INSTRUMENTATION. Final Report. Lenk, Pedro A.; McCreary, Joseph C. (Bailey Meter Co., Wickliffe, Ohio). Feb. 28, 1966. Contract AT(30-1)-3379. 199p. Dep. mn. CFSTI $5.00 cy, $1.25 mn.

Possible means of improvement for the present PM plants are discussed and recommendations for accomplishing this are given. Two approaches to system improvement are presented along with their respective cost estimates. Justification for each is provided and an evaluation of the degree of improvement obtainable is made. (M.O.W.)

20243 (ORNL-NSIC-7) SECONDARY SHUTDOWN SYSTEMS OF NUCLEAR POWER PLANTS. Walker, C. S. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 93p. Dep. ORNL Free.

A survey of the provision and use of secondary shutdown systems in power and production reactors in the United States and in power reactors in France and the United Kingdom is presented. (D.C.W.)

20244 (ORNL-TM-1419) DEVELOPMENT OF DYNAMIC SEALS FOR OPERATION IN DRY HELIUM FOR THE EGCR CHARGE MACHINE ACTUATING CYLINDERS. Helms, R. E.; Neill, F. H. (Oak Ridge National Lab.,

Tenn.). Mar. 1966. Contract W-7405-eng-26. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Piston rings and shaft seals were developed for a 3-in. diam actuating cylinder for operation in dry helium in the EGCR charge machine. Tests simulating one year of charge machine operation, both with respect to cycles and temperature exposure and to seal surface rubbing, were performed on test cylinders. Successful performance of the seals resulted following vapor honing of the cylinder and shaft surfaces and coating the cylinder walls with a dry lubricant (Everlube 811). Use of piston rings fabricated from carbon wool impregnated Viton-B O-rings gave the lowest leakage. SP-3 type polymer guide rings were used on the piston to prevent metallic rubbing between the piston and the barrel of the cylinder. (auth)

20245 (RISO-M-241) REGULERING AF ET PHWR KRAFTVAERK. (Regulation of a PHWR Power Station). la Cour Christensen, P. (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). May 1965. 20p. Dep. mn.

A survey of the possibilities for automatic control for a PHWR power station is given. The aim for the control system is to enable the power station to deliver steam at constant temperature and pressure with the smallest temperature variations in the reactor at load variations. A simplified dynamic model for a PHWR power station was developed and used for investigation of different methods of control. The most promising method seems to be a combined control of steam pressure and coolant outlet temperature from the reactor and a regulation of the coolant flow in accordance with the generated electrical power. (auth)

20246 (RISO-M-312) AUTOMATISERING AF KRAFTVAERKER. EN OVERSIGT. (Instrumentation and Control of Power Plants. A Review). Nielsen, Poul (Atomenergikommissionen, Risoe (Denmark). Forsoegsinstitut). Sept. 1965. 32p. Dep. mn.

A review of trends in instrumentation and control of power plants is presented. Special attention is given to the problems involved in using process computers and wired program system made of solid-state logic modules. Details are given of both systems as applied to instrumentation and control of turbines. (auth)

20247 (TID-22694) REVIEW OF LOSS OF SERVICES TO REACTOR. EXPERIMENTAL GAS COOLED REACTOR. Study No. IV-301. De Agazio, A. (Allis-Chalmers Mfg. Co., Washington, D. C. Nuclear Power Dept.). Nov. 9, 1960. Contract AT(10-1)-925. 18p. ORAU.

The plant service systems were examined to determine the possible causes and consequences of failure which could result in hazardous conditions or seriously interfere with the safe operation of the reactor. The services examined are fire water, domestic water, raw water, condenser water, ventilating air, compressed air, electrical, vessel cooling, and the service machine cooling. (M.O.W.)

20248 (TID-22707) 237 MW KRB NUCLEAR POWER PLANT. Quarterly Report, July 1-September 30, 1965. (Kernkraftwerk Rwe-Bayerwerk G.m.b.H., Gundremmingen (West Germany)). 88p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Results are presented for work done during this period on construction, preliminary tests, diagrammatical representation of construction status, and the status of the total project. (M.O.W.)

20249 (TID-22738) SUMMARY OF DESIGN OF EGCR REACTOR COOLANT SYSTEM. Beasley, E. G. (Tennessee Valley Authority, Oak Ridge). July 19, 1965. Contract AT(40-1)-2742. 7p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The design and stress analysis of the pressure-containing components of the EGCR cooling system is summarized. (D.C.W.)

20250 (TID-22739) LEVITATION OF AN EGCR CONTROL ROD. Beasley, E. G.; Lence, J. T.; Mysinger, E. D. (Tennessee Valley Authority, Oak Ridge). Feb. 18, 1965. Contract AT(40-1)-2742. 72p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Certain coolant system failures which might result in an upward force on a control rod were investigated. The following failure were considered; control rod nozzle closure not completely locked, complete circumferential failure of the control rod nozzle above the bottom of the shield plug, a rupture of a control rod nozzle above the top of the shield plug such that the shield plug cannot be ejected, rupture of the control rod nozzle interior coolant such that the cross sectional area of the rupture is at least equal to the cross sectional area of the pipe, and rupture of a control rod nozzle at or below the bottom of the shield plug. (M.O.W.)

20251 (TID-22740) PROCEDURE FOR DETERMINING THE DEPRESSURIZATION RATE OF THE EGCR PRIMARY SYSTEM IN THE EVENT OF COMPONENT FAILURE. Beasley, E. G.; Coffey, J. A.; Mills, L. M. (Tennessee Valley Authority, Oak Ridge). Sept. 1964. Contract AT(40-1)-2742. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A theoretical study of the pressure differential across the EGCR primary system components and of the rate of depressurization of the primary system in the event of ruptures of various sizes and locations in the primary system is summarized. (D.C.W.)

20252 (TID-22741) EGCR CONTROL ROD STUDIES. Carson, C. E.; Laughon, K. O. (Tennessee Valley Authority, Oak Ridge). June 3, 1965. Contract AT(40-1)-2742. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The results of some calculations of the worths of individual control rods and combinations of control rods are presented. The method of calculation is outlined. (D.C.W.)

20253 (TID-22742) CALCULATION OF COMBINED TEMPERATURE COEFFICIENT OF REACTIVITY FOR THE EGCR. Carson, C. E.; Price, L. K. (Tennessee Valley Authority, Oak Ridge). May 11, 1965. Contract AT(40-1)-2742. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The calculations of the combined or isothermal temperature coefficient of reactivity in the EGCR are described. Results are presented for the temperature range of 300 to 2,400°K, and burnup range from zero burnup to approximately 12,000 Mwd/mt. (auth)

20254 (TID-22743) ACCIDENT CONSEQUENCES FOLLOWING THE EJECTION OF A CONTROL ROD FROM THE EGCR CORE. Culver, H. N.; Keeton, D. C. (Tennessee Valley Authority, Oak Ridge). Apr. 26, 1965. Contract AT(40-1)-2742. 69p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The thyroid dose to the general public at the low population boundary and at the exclusion radius was evaluated for the postulated condition of ejecting a single control rod from the core for two representative conditions of fully inserted rods. Conservative fuel failure criteria were used to determine the number of fuel element failures during the accident. The analysis indicates that approximately 25 percent of the fuel elements could fail during the accident. The radiological hazards to the general public are evaluated, assuming activity is released directly to the reactor building at a rate determined by the oxidation of the UO_2. (M.O.W.)

20255 (TID-22744) NUCLEAR POWER REACTOR SITING. Culver, H. N. (Tennessee Valley Authority, Oak Ridge). Feb. 4, 1965. Contract AT(40-1)-2742. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The evaluation of a site for a reactor that is still in the design stage is discussed. The determination of distance factors is considered in some detail, particularly the reduction of distance factors through engineered safeguards. (D.C.W.)

20256 (TID-22745) INFORMATION PROVIDED TO OPERATORS FOR USE UNDER DEPRESSURIZATION ACCIDENT CONDITIONS. Culver, H. N. (Tennessee Valley Authority, Oak Ridge). Oct. 2, 1964. Contract AT (40-1)-2742. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The procedures to be followed in the event of a depressurization accident are outlined, together with the information that the operator must have in order to deal with the situation. (D.C.W)

20257 (TID-22746) A SUMMARY OF ACCIDENT CONDITIONS INVESTIGATED IN DETERMINING THE MAXIMUM CREDIBLE ACCIDENT FOR THE EGCR. Culver, H. N. (Tennessee Valley Authority, Oak Ridge). Sept. 28, 1964. Contract AT(40-1)-2742. 11p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The accident conditions that were investigated in determining the maximum credible accident for the EGCR are summarized. (D.C.W.)

20258 (TID-22748) STRUCTURAL ADEQUACY OF THE EGCR STEAM GENERATORS DURING THE PRIMARY SYSTEM DEPRESSURIZATION ACCIDENT. Domer, R. G. (Tennessee Valley Authority, Oak Ridge). Oct. 5, 1964. Contract AT(40-1)-2742. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Calculations of the pressure differentials that are required to cause failure of the various components of the steam generators are summarized. (D.C.W.)

20259 (TID-22749) DISTURBANCES IN THE EGCR CORE. Domer, R. G. (Tennessee Valley Authority, Oak Ridge). June 3, 1965. Contract AT(40-1)-2742. 31p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Disturbances were noticed by several persons working inside the upper plenum of the reactor pressure vessel. An analysis made to ascertain the causes and magnitude of these disturbances is reported. Results of the analysis are discussed. (M.O.W.)

20260 (TID-22753) PROPOSALS FOR EGCR REACTOR KINETICS EXPERIMENTS UTILIZING NOISE-ANALYSIS TECHNIQUES. Keeton, D. C. (Tennessee Valley Authority, Oak Ridge). June 11, 1965. Contract AT(40-1)-2742. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The kinetics experiments to be performed on the EGCR during Phase IV and V tests with noise-analysis methods are described. These tests will be performed with the reactor at various power levels up to full power. Noise-analysis techniques used during the startup are described. (auth)

20261 (TID-22754) A COMPUTER STUDY OF A RATE-OF-CHANGE-OF-PRESSURE SCRAM SYSTEM. Keeton, D. C. (Tennessee Valley Authority, Oak Ridge). Mar. 7, 1965. Contract AT(40-1)-2742. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A proposed rate-of-change-of-pressure scram system to be used during Phase IVa EGCR physics tests is described. The results of calculations to determine an optimum pneumatic system are presented along with a method of calibrating the flow orifice before it is connected into the system. Results of tests to determine the orifice size required for this application are shown. No detailed plans for the electrical portion of the system are presented. (auth)

20262 (TID-22755) TRANSIENT CALCULATIONS FOR THE EGCR BASE CASE ACCIDENT. Keeton, D. C.; Smith, D. (Tennessee Valley Authority, Oak Ridge). Nov. 13, 1964. Contract AT(40-1)-2742. 25p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An investigation of the re-attainment of criticality following a depressurization accident is summarized. The results of calculations that were made to determine the resulting transient power generation and core temperature are presented. The effects of several physical core parameters, as well as various reactivity release rates, on the transient are considered. (D.C.W.)

20263 (TID-22758) HYDRAULICS AND HEAT TRANSFER: BWR. Lence, J. T. (Tennesse Valley Authority, Oak Ridge). June 22, 1965. Contract AT (40-1)-2742. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An analysis of the pressure drop and cladding temperature in a boiling-water reactor is summarized. The effect of the buildup of oxide film on the cladding temperature is considered in detail. (D.C.W.)

20264 (TID-22760) REACTOR COOLANT SYSTEM RATE-OF-CHANGE-OF-PRESSURE (dp/dt) TRIP. Munns, J. M. Jr. (Tennessee Valley Authority, Oak Ridge). Aug. 12, 1964. Contract AT(40-1)-2742. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Two methods were investigated for possible use in actuating a reactor coolant system dp/dt trip. The results of the two experiments are presented. (M.O.W.)

20265 (TID-22768) KINETICS OF POSITIVE AND NEGATIVE PERIOD MEASUREMENTS IN THE EGCR. Smith, D.; Keeton, D. C. (Tennessee Valley Authority, Oak Ridge). May 5, 1965. Contract AT(40-1)-2742. 36p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The effect of various experimental parameters and the optimum method for making period measurements in the EGCR were examined. The results are presented in two main parts, one which considers positive period measurement only and the other which considers the sequence of measurements in which a positive period is followed by a negative period measurement. (M.O.W.)

20266 (TID-22770) CONTAINMENT VESSEL ELECTRICAL PENETRATIONS—A STUDY OF PERIODIC TEST METHODS. Tulis, Robert C. (Tennessee Valley Authority, Oak Ridge). June 1, 1965. Contract AT(40-1)-2742. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

In keeping with the high standards of safety set for reactor operations, sources of leakage from containment vessels must be sought out and eliminated. EGCR electrical penetrations which leave the containment vessel through 21 penetration pipes of 2-foot diameter were investigated. There are 24 such pipes, but three are currently blanked off. This investigation attempted to seek means whereby pressure could be periodically and locally applied to these penetrations to determine their tightness. (auth)

20267 (UJV-1046) VYPOCET KRITICKYCH ROZMERU A EFEKTIVNI VSAZKY VICEPASMOVEHO TEZKOVODNIHO REAKTORU S PRIRODNIM URANEM. METODIKA VYPOCTU A POPIS PROGRAMU. (Determination of Critical Size and Effective Fuel Charge of Heavy Water Natural Uranium Reactor with Multizone Active Core. Calculation Method and Description of Programming). Pfann, J.; Markvart, J.; Sulc, P. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1966. 34p. Dep. mn.

Algorithms are described for determination of critical parameters and neutron density distribution in two-group diffusion approximation applied to heterogeneous heavy water gas-cooled power reactor with multizone active core and multiregions reflector. In addition, effective fuel charge and other necessary parameters as neutron flux flattening, etc. are presented. The autocode program designed for numerical solution of introduced algorithms is described. The method is designed for active core optimization. (auth)

20268 (UJV-1422) OPTIMALISACE AKTIVNI ZONY A VYPOCET DOBY ODSTAVENI TEZKOVODNIHO REAKTORU S PRIRODNIM URANEM. CAST II. METODIKA A SPOJENY PROGRAM. (Optimization of Reactor Active Core and Calculation of Restarting Time of Heavy Water Reactor with Natural Uranium. Part II. Programming Method). Pfann, J.; Markvart, J.; Sulc, P. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1966. 27p. Dep. mn.

A combined autocode digital computer program is de-

scribed for calculating physical lattice parameters, critical size, and effective fuel charge of heavy water gas-cooled multizone power reactor with natural uranium. In addition a gradient method of effective fuel charge optimization and its application is presented. The above mentioned program is also adapted to calculation of restarting time after emergency shutdown, when using reactivity compensated with moderator press up elements in the central zone of the active core. (auth)

20269 (UJV–1454/65) IZMERENIE OSLABLENIYA NEITRONNYKH POTOKOV V MAKETE VERKHNEI BIOLOGICHESKOI ZASHCHITY REAKTORA. (Measurements of Neutron Flux Attenuation in Reactor Biological Shielding Model). Stoches, B.; Kadlets, V. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 51p. Dep. mn.

In view of its structural complexity, the proposed design for the upper biological shield of the KS-150 reactor of the Czechoslovak atomic power plant was tested by subjecting its mockup to the neutron flux in the thermal column of the VVR-S experimental reactor at Řež. The simplified mockup consisted of a cast-iron ring and concrete. Activation measurements revealed that the horizonal flux distribution was less uniform than the vertical distribution; similar measurements indicated that a boron carbide layer placed at 10 cm from the mockup attenuated the flux by a factor of 40; it was used in all tests involving thermal and epithermal neutrons. The system was air-cooled in order to keep the temperature of the mockup at 30°C. The geometric attenuation, measured by means of phosphorus was found to lie between 3.5 and 4. A scintillation probe was also used in the measurements. Theoretical calculations of the relaxation length by means of the RASH B and RASH D codes agreed with the experimental findings. It was concluded that the thermal column is well suited for this type of measurements. For fast neutron measurements the use of activation detectors is recommended, even though they are less sensitive. (TTT)

20270 (WAPD-TM-483) SUMMARY DESIGN REPORT FOR MELBA TEST IN PWR CORE 2 BLANKET. Henke, R. L. (ed.) (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar. 1966. Contract AT-11-1-GEN-14. 68p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A Multipurpose Extended Life Blanket Assembly (MELBA) was constructed and installed in the center blanket region of the Shippingport reactor containing PWR Core 2. Utilizing nine partially depleted fuel bundles taken from selected blanket fuel assemblies at the end of the PWR Core 1 lifetime, their further operation in Core 2 is intended to determine the burnup limitations of production grade Zircaloy-clad UO_2 rod type fuel elements in power producing reactor environments. The PWR Core 2 requirements are discussed along with the Core 1 fuel bundle nuclear, metallurgical, thermal, and hydraulic performance. The design, fabrication, and out-of-pile proof testing of the MELBA structure are described. (auth)

20271 (WCAP–3385-6) SAXTON PLUTONIUM PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Jan. 1966. Contract AT(30-1)-3385. 27p. (EURAEC–1534). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The following analytical and experimental work was accomplished during the quarter; (a) The analysis required in preparation for the zero-power tests was completed. Anticipated boron concentration requirements and control rod worths were determined. (b) The analysis required in preparation for following the operating history of Saxton Core II was completed. (c) The experimental measurements program was begun. The required boron concentration for the cold, zero-power and the hot, zero-power conditions were approximately 170 ppM less than those predicted by the initial analysis. Power operation of 17 Mw(t) was achieved. Preliminary data are included. (M.O.W.)

20272 (WCAP–6079) YANKEE CORE EVALUATION PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1965. O'Boyle, M. J. (comp. and ed.) (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Jan. 1966. Contract AT(30-1)-3017. 80p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Major progress during the three-month period ending December 31, 1965 is summarized as follows: Underwater examinations and dimensional measurements of the intact assembly were completed. Results confirm earlier observations: the assembly is in very good condition; dimensional stability is excellent, exposed surfaces are predominantly clean and crud-free, and there are no apparent defects. Localized loose deposits on exterior surfaces of the Phase III fuel assembly were investigated quantitatively. Depths of these deposits were estimated with an improvised "scratch gauge" to be about 4 mils. In addition, representative samples of deposited material were "suction scraped" from four fuel rods and subjected to chemical, radiochemical and spectrographic analyses. The eight fuel rods scheduled for detailed post-irradiation examinations under the Phase III program were removed from the high burnup fuel assembly and transferred to the WPIF Hot Cell Laboratory. To date, all eight rods have undergone thorough visual inspections and dimensional measurements in the hot cells. (M.O.W.)

20273 (ORNL-tr–985) HANDLING OF SUBASSEMBLIES AND LOADING OF SLEEVES OF THE HEATED CORE WITH THE HELP OF AN AUXILIARY GRIPPER ON THE RAPSODIE ENGINEERING MOCK-UP. Bellet, J.; Chouard, P.; Talon, R. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report PNR/SEPR–65-004. Feb. 26, 1965. 100p. Dep. mn. JCL $8.60 fs, $3.20 mf.

The removal of several fuel subassemblies from the Rapsodie mock-up for inspection, for the introduction of thermocouples, and for the positioning of electric heating elements is outlined. The cleaning and inspection of some of the subassemblies is described, together with the reloading of several subassemblies. The auxiliary gripper was used in these loading and unloading operations. (D.C.W.)

20274 (ORNL-tr–988) 1000 MWe REACTOR DESIGN STUDY OF A HANDLING CELL. Sauvage, M.; Gumuchian, M. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires. Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated for Oak Ridge National Lab., Tenn., from report PNR/SEPR/65,008. Feb. 18, 1965. 41p. Dep. mn. JCL $4.60 fs, $1.43 mf.

Included is a supplementary chapter to the 1000-Mw(e) reactor design as presented in Geneva. A design is described that makes use of a cell instead of rotating plugs in order to carry out handling. The problems posed by the reactor block, storage, handling, and the handling cell were examined, with the stress placed on the last two points which present the greatest difficulties. Much remains unknown about the contamination of this cell by sodium at the time of handling. Methods are proposed to limit this contamination to the maximum and especially a program for study and tests was suggested which should permit an evaluation of the efficiency of the planned systems. (M.O.W.)

20275 ON THE DETERMINATION OF MICROSCOPIC REACTOR PARAMETERS USING AN EXPONENTIAL ASSEMBLY. IV. Kleijn, H. R. (Reactor Instituut, Delft, Netherlands). Koninkl. Ned. Akad. Wetensch., Proc., Ser. B, 69: 147-54(1966).

A discussion of physics problems introduced by the operation of nuclear superheat reactors with separate boiler and superheater section as in recently developed boiling water reactors is presented. (B.G.D.)

20276 SYSTEM CHEMISTRY OF A LARGE BWR. della Rocca, Carlo (SENN, Scauri, Italy). Nucleonics, 24: 39-46(Feb. 1966).

The system chemistry of the Garigliano boiling water power reactor is described. This description includes the power plant and the chemistry of the water reactor. Topics discussed include radiation-induced reactions, radioactivity, water purification, and testing. Separation factors between the reactor water and the primary drum are also considered. Radiolytic gas formation, gaseous activity release, the chemistry of the feedwater and of the primary water, and also primary water radiochemistry and liquid waste disposal are discussed. (J.F.P.)

20277 SOVIET HIGH-TEMPERATURE CONVERTER REACTOR. Koptelow, J. Phys. Bl., 21: 314-19(July 1965). (In German).

A brief description is given of the Soviet high temperature thermionic converter reactor. The construction of the installation, its design, and experimental and theoretical design investigations are reported. The power testing of the reactor is described. (J.S.R.)

20278 SOME GUIDES TO NUCLEAR POWER PLANNING. Rengel, J. C. (Westinghouse Electric Corp., Pittsburgh). Westinghouse Eng., 26: 14-15(Jan. 1966).

Programs for developing the full potential of the pressurized water reactor (PWR) are presented, with emphasis on the advantages of this reactor system over other types. It is suggested that the potential of the PWR is not fully realized, and that throughout the 1970's, it will be a leading contender for lower electric power costs. (TCO)

20279 AN APPRAISAL OF THE TECHNICAL AND ECONOMIC ASPECTS OF DUNGENESS B NUCLEAR POWER STATION. London, Central Electricity Generating Board, 1965. 25p.

The assessment of the Dungeness B advanced gas-cooled reactor and the next most attractive offer, the boiling reactor, is given. The assessment includes a technical assessment, operating characteristics, safety and siting, and an economic assessment. The development potential is also considered. (J.F.P.)

20280 DUNGENESS B—AGR NUCLEAR POWER STATION. London, Central Electricity Generating Board, 1965. 12p.

The design of the Dungeness B Reactor, which is the first reactor in Britain's second nuclear power program is described. This advanced gas-cooled reactor will have a net output of 1,200,000 kilowatts and will be the most powerful nuclear power station in the world. The reactor will be a more compact reactor producing steam suitable for modern high-efficiency turbogenerators similar to those used in the latest coal and oil-fired power stations. The fuel and fuel loading, turbogenerators, safety characteristics, and the development potential are also discussed. (J.F.P.)

20281 PROCEEDINGS OF THE AMERICAN POWER CONFERENCE. VOL. 27. Chicago, American Power Conference, 1965. 1198p. $10.00. (CONF-650429).

Separate abstracts were prepared for five of the 139 papers included. Fifteen other papers were previously abstracted for NSA (19: 31569-31573, 35640, 35815-35818, 42026, and 42121-42124). The remaining papers deal with power generation and distribution, power demands, power-plant technology, and water technology. (D.C.W.)

For abstracts of individual papers see: 20219, 20282–20284, and 20292.

20282 ADVANCED REACTOR SYSTEMS AND THEIR FUTURE APPLICATIONS. Wright, J. H.; Gray, J. C. (Westinghouse Electric Corp., Pittsburgh). Proc. Amer. Power Conf., 27: 221-32(1965).

The status of advanced reactor concepts is summarized; advanced converters, breeder reactors, and water reactors are considered. The future application of nuclear power to the production of electricity is also discussed. (D.C.W.)

20283 THE WORLD NUCLEAR POWER SITUATION IN LIGHT OF THE 1964 GENEVA CONFERENCE. Roddis, Louis H. Jr. (Pennsylvania Electric Co., Johnstown). Proc. Amer. Power Conf., 27: 277-86(1965).

The status of nuclear power is summarized with emphasis on costs. (D.C.W.)

20284 ATOMIC POWER PLANTS—WHAT'S WRONG WITH THEM? Ackerman, Adolph J. Proc. Amer. Power Conf., 27: 737-55(1965).

The deficiencies and some unfavorable experiences in the technology of nuclear power plants during the last decade are summarized. The differences of opinions among engineers as to the safety and reliability of atomic power plants are also discussed. (G.O.Y.)

20285 PRESSURE WATER-COOLED NUCLEAR REACTOR WITH IMPROVED WATER CIRCULATING SYSTEM. Lange, Olof Harald Vilhelm (to Aktiebolaget Atomenergi). U. S. Patent 3,234,103. Feb. 8, 1966. Priority date Aug. 2, 1962, Sweden.

A system for use with a pressurized water-cooled reactor is designed in which the cooling water is heated up in the reactor core without boiling and the steam is generated without the use of ordinary heat exchangers. The system includes a vaporization chamber with a central inlet in the top for the highly heated water from the reactor. Baffles are provided in the vaporization chamber for imparting a rotary motion to the heated water to create in the middle portion of the chamber an annular rotating body of water and a central core of vaporized steam. The steam can be withdrawn, and a central outlet in the bottom of the chamber returns the water to the reactor for renewed heating. The outlet means can be arranged tangentially so as to build up a pressure sufficient to return the water to the reactor when receiving water from the rotating annular body, or baffles can transform the rotary motion of the annular rotating body of water into a substantial axial flow to build up sufficient pressure. (B.L.M.)

20286 THERMIONIC CONVERSION NUCLEAR REACTOR. Sankovich, Melvin F.; Schutt, Paul F. (to Babcock and Wilcox Co.). U. S. Patent 3,234,412. Feb. 8, 1966. Filed July 21, 1961.

An integrated nuclear reactor system is patented that employs both direct thermionic energy conversion and indirect heat energy conversion in transforming the heat into usable energy. The reactor core is formed by a number of thermionic conversion assemblies each of which contains a multiplicity of thermionic conversion nuclear fuel cells. The coolant fluid can be circulated through the core to remove the residual heat remaining subsequent to the thermionic conversion phase. Each thermionic conversion fuel cell is made up of a pair of similarly shaped thermionic conversion elements, each of which comprises a cathode and anode arranged in closely spaced relationship to form a plasma chamber between them. A pair of these elements is arranged so that at least a portion of the cathodes are in opposed spaced relationship with a body of nuclear fuel placed in the space provided between them to form the fuel cell, and the cathodes are joined together to form a closure for the nuclear fuel. Outside of this enclosure, means are sealingly attached to the periphery of each of the elements forming the cell to provide a sealed compartment about the cathodes for containing the gases released during the fission process. The cells within an assembly are connected so as to achieve maximum reliable service life as well as optimum power output. (B.L.M.)

Process Heat Reactors

20287 (AEEW-R-453) FIFI 3: A DIGITAL COMPUTER CODE FOR THE SOLUTION OF SETS OF FIRST ORDER DIFFERENTIAL EQUATIONS AND THE ANALYSIS OF PROCESS PLANT DYNAMICS. Sumner, Helen M. (Atomic Energy Establishment, Winfrith (England)). Nov. 1965. 44p. Dep. BIS $1.40. HMSO 7s.0d.

FIFI 3 is a FORTRAN Code embodying a technique for the analysis of process plant dynamics. As such, it is essentially a tool for the integration of sets of first order ordi-

nary differential equations, either linear or non-linear; special provision is made for the inclusion of time-delayed variables in the mathematical model of the plant. The method of integration is new and is centered on a stable multistep predictor-corrector algorithm. The theory on which the Code is based and detailed rules for using it are described. (auth)

20288 (BNWL-SA-596) ENVIRONMENTAL FACTORS RELATING TO LARGE WATER PLANTS. Parker, Herbert M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 15, 1966. Contract AT(45-1)-1830. 29p. (CONF-660311-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Symposium on Water Production Using Nuclear Energy, Tucson, Ariz.

A review of work done in marine biology, fisheries and environmental science, aquatic biology, environmental science, and nuclear and desalination engineering in connection with water production plants is presented. (M.O.W.)

20289 (HPR-65) HBWR QUARTERLY PROGRESS REPORT, OCTOBER TO DECEMBER 1965. (Institutt for Atomenergi, Halden (Norway). OECD Halden Reaktor Prosjekt). Feb. 1966. 155p. Dep. mn.

The various operations performed during this period are discussed. Detailed information on the reactor statics and dynamics and the heavy water coolant chemistry is given. In addition, the fuel irradiation test program is discussed in detail. Further component development for the reactor is reported. (M.O.W.)

20290 (NP-15920) A PRELIMINARY REPORT ON AN HWR PLANT FOR ELECTRIC POWER AND WATER DESALINATION. (Canadian General Electric Co. Ltd., Peterborough (Ontario). Civilian Atomic Power Dept.). Sept. 1963. 13p. Dep. mn.

The Canadian HWR was investigated for use as a dual-purpose reactor. Economics are discussed. (M.O.W.)

20291 CYCLES FOR SUPPLYING STEAM TO DESALTING EVAPORATORS OF DUAL-PURPOSE POWER-GENERATION PLANTS. Leung, Paul; Moore, Raymond E. (Bechtel Corp., Los Angeles). J. Eng. Power, 88: 22-6 (Jan. 1966).

Feasible cycles for supplying low-energy-level steam to the desalting flash evaporators of dual-purpose electric-generation and seawater conversion plants are presented and discussed. Cycles which generate electricity as the primary product and desalted water as the by-product are compared with cycles which produce water as the predominant product and electricity as the by-product. Investigations include fossil-fueled steam cycles and nuclear-fueled steam cycles at various pressures and temperatures. Determination of the most feasible cycles for various capacity ranges of water production and electrical generation are presented. (auth)

20292 THE ECONOMICS OF COMBINED ELECTRIC POWER AND WATER DESALINATION PLANTS. Scarbrough, B. R. (Westinghouse Electric Corp., Philadelphia); Stinson, W. H.; Nordman, D. A. Proc. Amer. Power Conf., 27: 167-72(1965).

The economics of dual-purpose plants are discussed, following a brief consideration of the technical feasibility of such plants. (D.C.W.)

Production Reactors

Refer also to abstracts 20232 and 20233.

Propulsion and Space

See also ENGINEERING — Space Propulsion

Refer also to abstract 18891.

20293 (JPL-TR-32-808) AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF CONCENTRATION RATIO DISTRIBUTIONS IN A BINARY COMPRESSIBLE VORTEX FLOW. Pivirotto, Thomas J. (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena). Mar. 15, 1966. 44p.

A scheme for containing fissionable material in the gas phase in a gaseous-core, nuclear-reactor propulsion system is considered. The results of a referenced analysis of this concept indicate that a rotating annular cloud of highly concentrated fuel gas can be retained in a steady, two-dimensional, potential vortex flow. The primary objective was to experimentally determine whether a real vortex flow can sustain an annular cloud of a high-molecular-weight gas at room temperature and to determine analytically and experimentally how this cloud is influenced by several of the flow parameters. Qualitative agreement between the theoretical radial distributions of the heavy to light gas mass density ratio and the measured distributions was found. However, the experimentally determined distributions were found to vary significantly and monotonically from one axial plane to the next, being radially more uniform near the end wall not containing the exit orifice and displaying a definite peak near the opposite end of the vortex tube. In addition, the maximum enrichment factor was found experimentally to increase as the heavy gas mass flow rate was decreased at each of three hydrogen mass flow rates tested. This behavior of the maximum enrichment factor was also found for the analytical model. From the analysis based on a two-dimensional (no axial velocities) potential vortex flow, a critical light gas mass flow rate, with respect to achieving large maximum enrichment factors, was found. This means that if, for any given set of conditions, the actual radial mass flow rate is greater than this critical rate the maximum enrichment factor will be modest, whereas, if the mass flow rate is reduced below the critical rate, the maximum enrichment factor becomes very large indeed. (auth)

20294 (LA-3446) GAMMA DOSE RATE MEASUREMENTS—KIWI TRANSIENT NUCLEAR TEST. Sanders, Fred W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Dec. 1965. Contract W-7405-eng-36. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Gamma-ray dose rates were measured after the destruction test of a prototype nuclear rocket reactor which was designated the Kiwi Transient Nuclear Test. Dose rates were measured around the test point out to 500 feet and in the downwind direction out to 8,000 feet. It was found that even as close as 100 feet from the test point dose rates were affected by wind direction. The passage of the effluent cloud was observed at 4,000 and 8,000 feet. Isodose rate contours were determined at several post-event times, and estimates of integrated dose to personnel making emergency entries were prepared. (auth)

20295 (LA-DC-7514) MEASUREMENT OF PRESSURE-TO-PRESSURE TRANSFER FUNCTIONS THROUGH THE PHOEBUS-1A NUCLEAR REACTOR. Johnson, James A. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 21p. (CONF-660206-3). ORAU.

From Symposium on Neutron Noise, Waves, and Pulse Propagation, Gainesville, Fla.

During the full power hold of the Phoebus-1A Nuclear Reactor test series, a pseudo-random noise signal was introduced into the turbo-pump flow demand and, with pre-emphasis, into the turbo-pump speed demand to cause pressure fluctuations in the reactor coolant system. The purpose of this experiment was to obtain dynamic response measurements of coolant pressure from the nozzle inlet plenum to the core exit plenum. The amplitude of the pressure perturbations in the nozzle inlet plenum was 17.5 psi peak-to-peak and 6.6 psi peak-to-peak in the core exit plenum. The pressure-to-pressure transfer functions of the nozzle coolant tubes, the reflector, and the core were obtained over a limited range of frequencies during the same experiment. The data were analyzed using the cross-correlation method. The results were excellent and essen-

tially in agreement with the predictions for the experiment. The range of frequencies covered by the experiment is from 0.2 to 10 cps. (auth)

20296 (N-65-21462) RESEARCH IN AND APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL. VOLUME II. Semiannual Status Report, September 1, 1964–February 1, 1965. Melsa, James L.; Schultz, Donald G. (Arizona Univ., Tucson. Dept. of Nuclear Engineering). Mar. 1965. 165p. (NASA-CR-62187). CFSTI $5.00 cy, $1.00 mn.

The second method of Liapunov is used as a basis for developing a method of closed-loop time-optimal control of linear systems with bounded control norm. The second method is combined with the minimum principle in an optimization approach centering on a special class of solutions for the Hamilton-Jacobi equations. When these solutions, called eigenvector scalar products, are used for the control of systems in which the control matrix is nonsingular, it is possible to find surfaces which bound the optimal isochrones in an unusually simple manner. When the control matrix is allowed to be singular, it is no longer possible to develop a single method; effective suboptimal control is obtained by using the Bang-Coast method and the switched control method. Procedures are outlined for applying these suboptimal methods to some practical control problems, and two simple nuclear rocket control problems are used as illustrations. In each case, the method is shown to represent an effective compromise between system complexity and speed of response. (STAR)

20297 (NAA-SR-11193) DEVELOPMENT OF NOISE AND ANALYSIS TECHNIQUES FOR MEASURING REACTOR COOLANT VELOCITIES. Randall, R. L.; Pekrul, P. J.; Grayban, G. R. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT-11-1-GEN-8. 32p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The development of cross-correlation techniques and equipment for measurement of localized fluid velocities and flow distribution in hydraulic test models of SNAP reactor cores is described. The hydraulic test models are instrumented with electrical conductivity cells. Particular emphasis is given to the hydraulic apparatus and electronic data acquisition and reduction system. The basic approach is experimental with supplemental theory introduced as needed. A number of experiments are discussed in addition to the S8DS core baffle and velocity profile studies. These experiments include axial and crossflow tests and conductivity cell device studies. An improved cell design is discussed and an error analysis is presented for the S8DS core studies and the improved cell. (auth)

20298 (NAA-SR-11762) DEVELOPMENT OF A SOLID-STATE NEUTRON DETECTOR FOR SNAP-10A. Chesavage, A. (Atomics International, Canoga Park, Calif.). Mar. 25, 1966. Contract AT(11-1)-Gen-8. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Electronic devices, primarily semiconductors, degrade in a nuclear radiation environment. In a reactor environment most of the damage is due to fast neutrons. The lithium hydride shield on SNAP 10A was designed to attenuate the fast neutron exposure at the instrument compartment to a tolerable level. To evaluate shield effectiveness fast neutron detectors were developed. Eight detectors were installed in the SNAP 10A FS-4 flight system. The development and in-flight data of these detectors are discussed. (M.O.W.)

20299 (NP-15903) A PLASMA CORE NUCLEAR ROCKET UTILIZING A MAGNETOHYDRODYNAMICALLY DRIVEN VORTEX. Johnson, K. P. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Oct. 1964. 59p. (SM-46285).

An approach to fuel containment for a gaseous core nuclear rocket which combines advantages of the coaxial jet and magnetohydrodynamically driven vortex concepts is proposed. An analysis of the diffusional aspects of fuel containment in an MHD driven vortex is presented, including radiant heat transfer. This is related to the requirement for large axial propellant flows. The device offers the prospect of high power density, high specific impulse, and economic fuel retention time. (auth)

20300 (NP-15904) FUEL CONTAINMENT BY AN MHD-DRIVEN VORTEX FOR A PLASMA CORE NUCLEAR ROCKET. Johnson, K. P. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). May 1965. 141p. (SM-46491).

A concept for a plasma core nuclear rocket is presented which utilizes Lorentz forces to drive a vortex. The control of diffusion processes by the vortex isolates a zone of fuel from zones of propellant within the vortex. The primary propellant flows by-pass the fuel in the axial direction, receiving heat by radiant transport. A parametric study of fuel containment conditions is presented for a simplified two-dimensional model, including radiant heat transport. The study indicates that laminar vortex flow would provide containment of a critical mass of fuel. The pressure level required to achieve criticality decreases with cavity radius, tending to require radii exceeding 1m. Electric power requirements for driving the vortex are modest compared to reactor power levels. Typical reactor power levels exceeding 50,000 Mw provide thrusts exceeding one million pounds at a specific impulse of 2500 sec. (auth)

20301 (NP-15906) CONCEPTUAL DESIGN STUDY OF THE GLOW PLUG GASEOUS CORE REACTOR. Ross, F. A.; Holl, R. J. (Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.). Nov. 15, 1963. 65p. (SM-44042).

In a preliminary thermal design study of the glow plug gaseous core reactor, the effects of variations in propellant flow rate and exit temperature, tube size, physical core configuration and flow path were investigated parametrically to identify and indicate the magnitude of design limitations. The three tube materials studied were sapphire (Al_2O_3), fused silica (SiO_2), and magnesia (MgO). Of these materials, the study revealed that only the fused silica is clearly acceptable for the application from a thermal stress consideration. (M.O.W.)

20302 (SC-RR-65-472) CONTROLLED DEORBIT. Leonard, J. A.; Joseph, W. W. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1966. Contract AT(29-1)-789. 47p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Controlled deorbit is discussed as a means of disposal of orbiting SNAP satellites to reduce radiological hazards. Two types of controlled deorbit systems are considered: the command initiated retro-rocket system and the command deployable high-drag device. An example situation of deorbit from an eccentric transfer orbit, similar to that flown by SNAP-10A, is examined. (auth)

20303 LIQUID METALS IN SPACE POWER SYSTEMS. De Mastry, John A. (Battelle Memorial Inst., Columbus, Ohio). Battelle Tech. Rev., 15: No. 3, 17-21(Mar. 1966).

The various proposed Systems for Nuclear Auxiliary Power (SNAP) and the liquid metals considered for use in them are reviewed. The technology of liquid metal use as a coolant or a working fluid for such systems, the SNAP program including SNAP 10A, and SNAP-50/SPUR, the Sunflower power conversion system, and thermionic converters are considered. (J.F.P.)

20304 NUCLEAR PROPULSION OF SPACE ENGINES. Spincourt, Jacques. Sci. Progr.-Nature, No. 3369, 26-8 (Jan. 1966). (In French).

The Kiwi experiments on the advantages of solid-core and gaseous-core reactors for space propulsion are briefly indicated. (J.S.R.)

20305 SPACE NUCLEAR POWER GENERATORS. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-NINTH CONGRESS, FIRST SESSION, AUGUST 6, 1965. Washington, D. C., Joint Committee on Atomic Energy, 1966. 281p. GPO $1.00.

The hearings on space nuclear power generators include

the SNAP isotopic units and reactors, and the SNAP program, the Brayton cycle, cost analysis and comparison of space power sources, the combined rotating unit, curium, fuel cells, the IMP mission, ion engines, the Mariner, and the medium power reactor experiment. Also included are missions for space power units SNAP-19, plutonium-238, polonium-210, the Rankine cycle, reentry, SNAPSHOT, solar cell, the Surveyor, test facilities, thermionic reactors, and the 710 reactor. (J.F.P.)

Research and Test Reactors

Refer also to abstract 20239.

20306 (ACNP-62599(Vol.1)) AIR FORCE NUCLEAR ENGINEERING TEST FACILITY SAFEGUARDS REPORT. VOLUME 1. TEXT. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.). Aug. 1963. 443p. Dep. mn. CFSTI $7.43 cy, $2.00 mn.

For Maxon Construction Co., Inc., Dayton, Ohio.

Separate detailed discussions are presented for each of the following: site and surrounding region, facility description, reactor core and vessel, experimental facilities, thermal and biological shielding, containment, cooling systems, waste-handling system, radiation monitoring system, reactor instrumentation and control system, tests and facility operation, hazards associated with normal reactor operation, and accident analysis. In addition, the appendices present detailed results on the following: geology and hydrology of the site, diffusion climate in the vicinity of the reactor, modified Mercalli intensity scale, reactor physics analysis, thermal and hydraulic analysis, safeguards for initial startup, and an emergency plan for reactor checkout. Volume 2 contains all related diagrams. (M.O.W.)

20307 (ACNP-62599(Vol.2)) AIR FORCE NUCLEAR ENGINEERING TEST FACILITY SAFEGUARDS REPORTS. VOLUME 2. FIGURES. (Allis-Chalmers Mfg. Co., Milwaukee, Wis. Atomic Energy Div.). Aug. 1963. 190p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

For Maxon Construction Co., Inc., Dayton, Ohio.

Diagrams are included which correspond to the topics discussed in Volume 1. (M.O.W.)

20308 (AECL-2544) MAIN SHIELD FOR WHITESHELL REACTOR NO. 1. Szilvasi, A. J (Canadian General Electric Co. Ltd , Peterborough (Ontario). Civilian Atomic Power Dept.). Nov. 1964. 338p (R-64CAP59). Dep. mn.

Shield thicknesses for the WR-1 main shield system were calculated. The detailed results of these calculations are presented. (M.O.W.)

20309 (AECL-2545) SECONDARY SHIELD DESIGN FOR WHITESHELL REACTOR NO. 1. Szilvasi, A. J (Canadian General Electric Co. Ltd., Peterborough (Ontario). Civilian Atomic Power Dept.). Nov. 1965. 101p. (R-65CAP17). Dep. mn.

Necessary shield thicknesses to shield against the secondary sources (spent fuel, coolant, and heavy water) of WR-1 were calculated. The detailed results are presented. (M.O.W.)

20310 (AEEW-R-465) DOPPLER COEFFICIENT MEASUREMENTS IN ZEBRA CORE 5. Baker, A. R.; Wheeler, R. C. (Atomic Energy Establishment, Winfrith (England)). Nov. 1965. 30p. Dep. BIS $0.90. HMSO 4s. 6d.

Measurements using a central hot loop in Zebra Core 5 are described. Results are given for the Doppler coefficients found in a number of assemblies with PuO_2 and 16% PuO_2/84% depleted UO_2 pins, loaded with different combinations of steel, sodium or void pins. The mixed oxide results are in general about 20% more negative than was calculated using the FD2 data set, but agreement is good if the plutonium contributions in the calculations are omitted. The small positive Doppler coefficient calculated for ^{239}Pu was not observed, and two measurements indicated instead a small negative effect. The Doppler effect in the mixed oxide systems was found to vary approximately as 1/T. The results from the empty loop and non-fissile assemblies indicate either a small negative Doppler effect in steel or alternatively the presence of an unexplained expansion effect. (auth)

20311 (EIR-87) ANALYZER FOR MEASURING THE TRANSFER FUNCTION ON THE REACTOR SAPHIR. Winkler, H.; Huerlimann, T.; Patry, J.; Schmid, P. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jan. 1966. 44p. (CONF-610902-1). Dep. mn.

From EAES Symposium on Reactivity Feedback Mechanisms and Nuclear Reactor Stability, Zurich.

The construction and use of an analyzer for measuring the transfer function of the swimming pool reactor SAPHIR are described. Measurements carried out at various power levels and the evaluation of a reactivity feedback function are discussed. (auth)

20312 (IDO-17060) POWER BURST FACILITY PRELIMINARY SAFETY ANALYSIS REPORT. Barton, D. R.; Bennett, G. L.; Carpenter, W. R.; (and others) (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 1965. Revised, June 1965. Contract AT(10-1)-205. 440p. Dep. mn. CFSTI $7.40 cy, $2.00 mn.

Included are: descriptions of the site, reactor and control buildings, reactor core, control systems, instrumentation and supporting facilities; a brief statement of the experimental program; a discussion of postulated accidents; and an analysis of the radiological consequences of two "referent accidents." The appendices discuss: the current status and test results of the PBF fuel testing and transient rod drive testing programs; additional analytical detail relative to core physics, heat transfer, radiation shielding, and radiological hazards; and additional detail relative to facility design. (M.O.W.)

20313 (RT/ING-(65)18) PORTACAMPIONI GIREVOLE PER IRRAGGIAMENTO SIMULTANEO DI PROVETTE NEL REATTORE RC-1. (Rotary Specimen Rack for Simultaneous Irradiation of Test-Tubes in RC-1 Reactor). Marsili, F. (Comitato Nazionale per l'Energia Nucleare Rome (Italy)). Dec. 1965. 10p. Dep. mn.

The design, operation, and control of the electromagnetic device for the simultaneous irradiation of test tubes in the RC-I reactor are described. (J.S.R.)

20314 (STI/DOC-56(Vol.1)) UTILIZATION OF RESEARCH REACTORS. VOLUME I. Proceedings of a Study Group Meeting, Athens, 9-13 September 1963. (International Atomic Energy Agency, Vienna (Austria)). 1964. 340p. (CONF-426(Vol.1)). Dep. mn. IAEA.

Twenty papers were presented; separate abstracts have been prepared for thirteen papers. For abstracts of papers previously included in NSA see 18: 11494, 15483, 17286, 35218, and 35219. The remaining two papers were in summary form. (B.G.D.)

For abstracts of individual papers see: 20317-20329.

20315 (STI/DOC-56(Vol.2)) UTILIZATION OF RESEARCH REACTORS. VOLUME II. Proceedings of a Study Group Meeting, Athens, 9-13 September 1963. (International Atomic Energy Agency, Vienna (Austria)). 1964. 317p. (CONF-426(Vol.2)). Dep. mn. IAEA.

Twenty papers were presented. Separate abstracts have been prepared for sixteen papers. For abstracts of papers previously included in NSA see 18: 7684, 33447, and 35148. The paper not abstracted was a brief description of the neutron crystal spectrometer project of the Cekmece Nuclear Research Center. (B.G.D.)

For abstracts of individual papers see: 20164, 20165, and 20330-20343.

20316 (ZfK-RN-29) STRAHLENWARNANLAGE FUER DEN ROSSENDORFER RINGZONENREAKTOR. (Radiation Alarm Arrangement for the Rossendorf Annular Zone

Reactor). Matthes, Wilfried (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (East Germany)). Aug. 1964. 17p. Dep. mn.

A transistorized alarm system that monitors ten separate points of the reactor hall for gamma doses above the prescribed values for these points is described. (D.C.W.)

20317 REVIEW OF BASIC PROBLEMS FACING NEW RESEARCH REACTOR ESTABLISHMENTS. Khan, Munir (International Atomic Energy Agency, Vienna). pp 11-13 of STI/DOC/56(Vol.I).

A general discussion of basic problems which a new reactor research center will encounter is presented. Topics discussed are integration with scientific community, administrative organization, equipment, technical manpower and development of research programs. (B.G.D.)

20318 CEKMECE NUCLEAR RESEARCH AND TRAINING CENTER: ITS ORGANIZATION AND PROGRAMS. Akpinar, S. (Cekmece Nuclear Research and Training Center, Turkey). pp 15-21 of STI/DOC/56(Vol.I).

A discussion of the organization of the Cekmece Nuclear Research and Training Center is presented including organizational charts, distribution of personnel, policies and programs, cooperation with universities and other institutions, and training capability. An outline of all current research projects at the Center is presented. (B.G.D.)

20319 AN OUTLINE OF THE RESEARCH PROGRAMME OF BORIS KIDRIC INSTITUTE OF NUCLEAR SCIENCES. Mladjenovic, Milorad; Dizdar, Zdenko (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 25-57 of STI/DOC/56 (Vol.I).

The research programs of the Boris Kidrič Institute are outlined under the following headings: radiation production facilities, power reactor research and development, isotope production and fuel processing, fundamental research, and health and safety. (B.G.D.)

20320 UTILIZATION OF THE REACTOR JEN-1. Montes Ponce de Leon, J.; Dominguez Rodriguez, G. (Junta de Energia Nuclear, Madrid). pp 85-106 of STI/DOC/56(Vol.I). (In Spanish).

The instrumentation, neutron physics research, and radioisotope production at the JEN-1 research reactor are discussed. (C.E.S.)

20321 THE OPERATING EXPERIENCE OF TR-1. Cilesiz, A. (Cekmece Nuclear Research and Training Center, Turkey). pp 111-20 of STI/DOC/56(Vol.I).

The main features of the 1 Mw pool-type research reactor TR-1 are reviewed. Operational problems encountered are summarized. (B.G.D.)

20322 SOME SAFETY ASPECTS OF RESEARCH REACTOR OPERATION. Skjoeldebrand, R. (International Atomic Energy Agency, Vienna). pp 129-33 of STI/DOC/56(Vol.I).

A summary of general rules and principles of safety in the operation of research reactors is presented. (B.G.D.)

20323 RESEARCH REACTOR OPERATIONAL PROBLEMS INCLUDING STAFF REQUIREMENTS AND ORGANISATION FOR OPERATION AND MAINTENANCE NEED FOR SUPPORTING FACILITIES. Wood, W. F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 135-77 of STI/DOC/56(Vol.I).

A review of the overall problems in the operation of the research reactors at A.E.R.E., Harwell is presented. Topics discussed are responsibility of the Research Reactors Division, organization of supporting groups, staffing and training necessary to ensure safe operation and use of the reactors. Some information is given on the reactor usage and on the development and trends in requirements to meet changing needs of experimentation. (B.G.D.)

20324 OPERATIONAL PROBLEMS WITH "DEMOCRITUS" RESEARCH REACTOR. Chrysochoides, Nicholas; Mitsonias, Constantine (Nuclear Research Center Democritus, Athens). pp 179-88 of STI/DOC/56 (Vol. I).

A review of the operation of the 1 mμ swimming pool research reactor Democritus at Athens is presented, including operational problems and modifications. (B.G.D.)

20325 INSTALLATION, OPERATION AND PROGRAM OF THE ARBI REACTOR IN BILBAO. Albisu, F. (Escuela Tecnica Superior de Ingenieros Industriales, Bilbao, Spain). pp 189-202 of STI/DOC/56(Vol.I).

A summary of the experimental facilities, operation, and research programs of the ARBI reactor is presented. (B.G.D.)

20326 THE OPERATION OF THE ISPRA-1 REACTOR FROM CRITICALITY THROUGH 2/28/1963. Carrara, V.; Ovazza, M.; Villani, A. (CNEN, Ispra, Italy). pp 203-37 of STI/DOC/56(Vol.I).

Reactor activities of Ispra-1 from March, 1959 through February, 1963 are reviewed to present major operating information. (B.G.D.)

20327 THE R.T.M. FACILITY AT CASACCIA. Bracci, A.; Ovazza, M. (CNEN, Casaccia, Italy). pp 239-47 of STI/DOC/56(Vol.I).

The plans for a radiation facility at the Casaccia Center is briefly outlined including design criteria and a description of the reactor and associated facilities. (B.G.D.)

20328 SOME NOTES ON THE AUXILIARY EQUIPMENT INDISPENSABLE TO THE PROPER EXPLOITATION OF A RESEARCH REACTOR. Lalere, J. (Commissariat a l'Energie Atomique, Paris). pp 253-62 of STI/DOC/56 (Vol.I).

A general list of dosimetry laboratory equipment vital to the full utilization of research reactors is presented. The recovery of irradiated samples and precise dosimetry methods are summarized. (B.G.D.)

20329 WORK ON REACTOR PHYSICS AT THE BORIS KIDRIC INSTITUTE OF NUCLEAR SCIENCES. Raisic, Nenad (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 287-301 of STI/DOC/56(Vol.I).

A survey of work on reactor physics at the Boris Kidrič Institute of Nuclear Sciences is presented. The two aspects summarized are the basic research program, concentrated on the NPY International Project, and the GCR project. A description of the experimental facilities and the present status of research programs are also presented. (B.G.D.)

20330 ROLE OF RESEARCH REACTORS IN THE NUCLEAR ENERGY PROGRAM. Ristic, M. D. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 17-57 of STI/DOC/56(Vol.II). (In French).

A review is given of the modern program for developing nuclear energy. The role of the research reactor in realizing this program is discussed. Materials, finances and international cooperation are considered. The use of research reactors for studies relating to power reactors is outlined. Tables of presently existing research reactors indicating the country, type, and principal research use are included. (C.E.S.)

20331 CROSS SECTION AND SCATTERING EXPERIMENTS AT THE SWIMMING POOL REACTOR FRM IN MUNICH. Springer, Tasso (Kernforschungsanlage, Juelich, Ger.). pp 65-91 of STI/DOC/56(Vol.II).

A review is presented on cross section and scattering experiments which have been performed or are in progress at the slow neutron group of the FRM reactor in Munich. Some of the experiments include cross section measurements in the subthermal range, small angle scattering of long wavelength neutrons, differential scattering cross sections in the range of thermal neutrons, and free cross section measurements in the ev-range. (B.G.D.)

20332 EXPERIENCE OBTAINED IN ESTABLISHING A RESEARCH PROGRAMME IN NUCLEAR AND SOLID STATE PHYSICS AT A SMALL REACTOR CENTRE. Riste, T. (Institutt for Atomenergi, Kjeller, Norway). pp 127-33 of STI/DOC/56(Vol.II).

The establishment of a research program in nuclear and solid state physics for the heavy water reactor Jeep is briefly outlined. Current and future research programs are also included. (B.G.D.)

20333 THE RC-1 REACTOR AS A TOOL FOR TRAINING AND RESEARCH. Sciuti, S. (CNEN, Rome). pp 135-44 of STI/DOC/56(Vol.II).

A summary is presented on the research programs and experimental facilities of the Italian RC-1 Reactor (TRIGA Mark II). Research currently being done in pile neutron physics is polarized neutron beam experiments, slow chopper experiments, and nuclear spectroscopy. The uses of a research reactor as a training device for personnel is briefly discussed. (B.G.D.)

20334 GAMMA-RAY SPECTROSCOPY RESEARCHES WITH A 0.1 MW REACTOR. Sciuti, S.; Prosperi, D.; Giannini, M.; Nunberg, P. (CNEN, Rome). pp 145-60 of STI/DOC/56(Vol.II).

Descriptions of research projects, past and in progress using the RC-1 research reactor are presented. These projects include the use of (n_{th},γ) reactions for the study of nuclear levels study of highly excited nuclear levels (from 5 to 10 Mev) by means of resonant scattering and absorption of γ lines, and nuclear spectroscopy with radioactive sources produced in the reactor. (B.G.D.)

20335 SOLID STATE PHYSICS RESEARCH BY A 0.1 MW REACTOR. Paoletti, A. (CNEN, Rome). pp 161-84 of STI/DOC/56(Vol.II).

A review of research done in solid state physics with the use of the Italian RC-1 reactor is presented. The research was restricted to the use of polarized neutron techniques and the time-of-flight technique for total cross section measurements. Investigations of Fe_3Si and $MnNi_3$ alloys and high temperature coherent magnetic scattering of thermal neutrons by fcc cobalt are summarized. Characteristics of a slow chopper used for total cross section measurements are included. (B.G.D.)

20336 ESTABLISHMENT OF PILE NEUTRON RESEARCH AT THE NUCLEAR RESEARCH CENTER "DEMOCRITUS." Tsakarissianos, Denis T.; Simopoulos, Athanassios (Nuclear Research Center Democritus, Athens). pp 187-95 of STI/DOC/56(Vol.II).

An outline of the objectives involved in the establishment of a pile neutron research program at Democritus is presented. Current research projects and experimental facilities are included. (B.G.D.)

20337 UTILIZATION OF DEMOCRITUS REACTOR FOR CHEMISTRY RESEARCH WORK. (Nuclear Research Center Democritus, Athens). pp 209-14 of STI/DOC/56 (Vol.II).

A survey of the utilization of the swimming pool type reactor GRR 1 as an experimental tool in chemistry research is presented. The main utilizations consist of production of radioisotopes, application of certain isotopes to certain industrial and hydrological problems. hot atom chemistry, radiochemical and nuclear analysis, tracer studies, neutron activation studies, and radiation chemistry. (B.G.D.)

20338 STUDIES ON NUCLEAR CHARGE AND MASS DISTRIBUTIONS IN LOW-ENERGY FISSION. Talat-Erben, M. (Cekmece Nuclear Research and Training Center, Turkey). pp 231-9 of STI/DOC/56(Vol.II).

A general survey is presented on the possible utilization of research reactors in the field of fission chemistry, due to the need of a large amount of primary fission yield data for studies on nuclear charge and mass distribution in low-energy fission. (B.G.D.)

20339 PRODUCTION OF RADIOISOTOPES IN DEMOCRITUS REACTOR. (Nuclear Research Center Democritus, Athens). pp 243-5 of STI/DOC/56(Vol.II).

A brief summary is presented on the production of radioisotopes in the Greek swimming pool type reactor GRR-1. Topics discussed are utilization of the reactor, radioisotopes production facilities for handling radioisotopes, measurement and control, packing, and shipping of radioisotopes. (B.G.D.)

20340 PRODUCTION OF RADIOISOTOPES ON THE RA RESEARCH REACTOR IN YUGOSLAVIA. Dizdar, Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 247-82 of STI/DOC/56(Vol.II).

The establishment of a radioisotope production facility using the heavy water moderated research reactor RA in Yugoslavia is summarized. Topics discussed are the characteristics of the RA reactor with respect to radioisotope production, description of the radiochemical laboratory, preparation of materials for irradiation and the achievement of production with requirements on staff, facilities organization and research on production procedures. (B.G.D.)

20341 THE REACTOR AS A TOOL IN AGRICULTURAL RESEARCH. de Zeeuw, Dick (Inst. for Atomic Sciences in Agriculture, Wageningen, Netherlands). pp 289-93 of STI/DOC/56(Vol.II).

A general discussion of the fundamental concept of linear energy transfer (LET) and its consideration in an analysis of relative biological effectiveness (RBE) is presented. The main areas in which a reactor is used as a tool in agriculture research are included. The effects of slow and fast neutrons in agricultural research is briefly summarized. (B.G.D.)

20342 ADVANTAGES OF RESEARCH REACTORS USED FOR AGRONOMICAL STUDIES. Pereau-Leroy, P. (Commissariat a l'Energie Atomique, Cadarache, France). pp 295-8 of STI/DOC/56(Vol.II).

A general summary of techniques utilizing research reactors for agronomical studies such as the use of neutron flux of reactors in order to obtain mutation and improvement of cultivated plants, the use of activation analysis, and the use of short half-life isotopes to study nutrition and metabolism of plants is presented. (B.G.D.)

20343 SCIENTIFIC COOPERATION BETWEEN CEKMECE NUCLEAR RESEARCH AND TRAINING CENTER AND BROOKHAVEN NATIONAL LABORATORY. Akpinar, S. (Cekmece Nuclear Research and Training Center, Turkey). pp 303-7 of STI/DOC/56(Vol.II).

The establishment, provisions and research projects of the cooperative program between the Cekmece Nuclear Research and Training Center and the Brookhaven National Laboratory are summarized. (B.G.D.)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology.
CHEMISTRY — Radiochemistry.
CHEMISTRY — Separation Processes and Procedures.
HEALTH AND SAFETY.

20344 (BNL–10047) PHOSPHATE GLASS PROCESS: EVAPORATOR STUDIES WITH SIMULATED PUREX WASTES. Strickland, G.; Tuthill, E. J.; Drager, R. F. (Brookhaven National Lab., Upton, N. Y.). [1966]. Contract AT(30-2)-Gen-16. 24p. (CONF-660208–11). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

Preliminary studies were made on the continuous evaporation and denitration of simulated Purex wastes using a tube-bundle evaporator equipped with a turbine agitator. Operating experience and performance data were obtained with prototype design-basis feed at 150°C. Decreases in performance were generally related to the initial heating conditions rather than to the total time of operation. In the concentration of Purex-2 feed at temperatures of 123–145°C, the performance of the evaporator decreased at each higher temperature because of the increased volume reduction and solution viscosity. Recommendations include several design changes and continued testing in the vicinity of 130°C. (auth)

20345 (BNWL-SA–569) HOT-CELL STUDIES OF THE SPRAY AND POT CALCINATION OF FULLY RADIOACTIVE FUEL REPROCESSING WASTES. Moore, R. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 4, 1966. Contract AT(45-1)-1830. 15p. (CONF-660208–13). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

A small pilot plant for the experimental study of the calcination of full-level radioactive wastes was constructed in a large hot-cell at Hanford and operation initiated in 1962. Both radiant-heat spray calcination and pot calcination were proven operable. The radioactive off-gas was found to be readily decontaminated to safe discharge levels. The results obtained and implications for a full-size plant are discussed, as are techniques used for decontaminating the cell following over two years of operation. (auth)

20346 (ORNL–3824) A COMPUTER CODE FOR STORING AND RETRIEVING DATA AND DEVELOPING IMPROVED SOLIDS FOR FIXATION OF HIGHLY RADIOACTIVE WASTES. Fitzgerald, C. L.; Godbee, H. W.; Davis, M. H.; Clark, W. E. (Oak Ridge National Lab., Tenn.). Mar. 1966. Contract W-7405-eng-26. 106p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

A computer code was developed for storing, retrieving, and correlating the data generated by programs for the fixation of highly radioactive wastes in stable, solid media. Properties considered important for the design of equipment to produce these solids as well as the design of facilities to store them are included in the code. In addition to basic chemical composition of each mixture or melt, viscosity, thermal conductivity, heat capacity, volatility data, and corrosiveness are among these properties. The experimental data describing a melt is punched on standard 80-column data cards. The code as now programmed requires eight data cards to describe each melt. However, provisions are made so that 99 data cards may be used for each melt to provide for future additions as they are necessary. The mechanics of transferring experimental data to the data sheet is described in detail. A specific example is worked out item by item to illustrate the use of the data sheets. The flowsheet for the code and the FORTRAN II code are presented so that anyone desiring to use the code in toto can do so readily. Nearly five hundred melts were developed and included in the code. The melts were developed from wastes simulating those expected from the various Purex processes, the TBP-25 process, and the Darex process. About three hundred and fifty of the melts were developed for the Purex waste solution, about sixty for TBP-25 waste solutions, and about sixty for Darex waste solutions. A condensed readout of the more important properties for all melts developed at ORNL to date is presented. Any or all of the melt properties can be included in the readout depending on the listing desired. The code can accommodate all data currently generated and provides for possible addition of unforeseen variations in both compositions and properties. It will also provide a convenient way of exchanging data between different groups working on the fixation problem. Use of the code with additional input data to predict optimum melt compositions will be the subject of future work. (auth)

20347 (ORNL–P–2058) PROJECT SALT VAULT: DESIGN AND OPERATION. Empson, F. M.; Bradshaw, R. L.; Boegly, W. J.; McClain, W. C.; Parker, F. L.; Schaffer, W. F. Jr. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 20p. (CONF-660208–15). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

The demonstration disposal of high-level radioactive solids, initiated in November 1965 in the Carey salt mine at Lyons, Kansas, is known as Project Salt Vault. The objectives of the demonstration are: confirmation of feasibility and safety of disposal in salt mines; demonstration of required waste-handling equipment and techniques; determination of the stability of salt under the influence of heat and radiation; and collection of information on creep and plastic flow of salt, which is needed for the design of an actual disposal facility. Fourteen irradiated fuel assemblies from the Engineering Test Reactor serve as a source of radiation in lieu of actual solidified wastes. The assemblies, contained in seven cans, have been placed in an array of holes in the floor. During the course of the 2-year test, four sets of assemblies will be used to achieve a peak dose to the salt of about 8×10^8 rad and the temperature of the adjacent salt will be raised to 200°C with auxiliary electrical heaters. A second array will be installed in less pure salt at the end of the first 6 months, using the fuel assemblies which are now in the main array. A third array, consisting only of heaters, is being operated as a control to determine those effects due solely to heat. In addition to the radioactive and control arrays, a rib-pillar will be heated by electrical heaters at its base to produce additional information on salt flow characteristics at elevated temperatures. (auth)

20348 (RL-SA–60) HIGH INTEGRITY BULK PACKAGING FOR LONG-TERM STORAGE OF RADIOACTIVE WASTES. Kolb, J. W. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Feb. 9, 1966. Contract AT(45-1)-1851. 67p. (CONF-660208–12). Dep. mn. CFSTI $3.00 cy, $0.75 mn.

From Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash.

Facilities for packaging megacurie quantities of radioactive wastes (strontium-90, cesium-137) in all welded stainless steel helium leak-tight containers for long-term storage (many decades) or retrieval at any time are presented. Unique features of the facilities include: remote

operation in a separations plant canyon without the use of manipulators or dynamic penetration between the operating gallery and contaminated zone; remote encapsulation and replacement of equipment by canyon crane and impact wrench without shutdown, cell clean-up or contamination spread; equipment components except those that must contact container or waste stream located in clean zone; and remote clean-up of contaminated portion of equipment for subsequent contact maintenance at glove box. (auth)

20349 DECONTAMINATION OF RADIOACTIVE WASTE WATERS BY CONTACT PRECIPITATION. PART III. THE CALCULATION OF THE INVESTMENT AND OPERATING COSTS OF A PLANT USING CONTACT PRECIPITATION COMBINED WITH SUBSEQUENT ION EXCHANGE PURIFICATION. **Sachse, G.; Haentzschel, H.** (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 697-704(Dec. 1965). (In German).

A calculation of the cost of construction and operation of a plant with a capacity of 10 m^3/h was carried out on the basis of semitechnical experiments of decontaminating radioactive waste waters by contact precipitation and ion exchange. The investment cost of a plant of the capacity mentioned above for the two variants in account amounts to about 290,000 and 320,000 M, respectively. The operating cost of contact precipitation amounts to 0.99 M/m^3 for the one-stage plant, and to 0.94 M/m^3 for the two-stage one. Two variants were taken into account for decontaminating the radioactive waste waters by ion exchange: using the ionite in the Na−Cl form or in the H−OH form. Using the ionite in the Na−Cl form leads to a total operating cost of 2.45 M/m^3, using it in the H−OH form to that of 2.86 M/m^3. (auth)

20350 FURTHER STUDIES ON THE UPTAKE OF LONG-LIVED FISSION PRODUCTS ON SOME CLAYS FROM THE UNITED ARAB REPUBLIC. **Mitry, E.; Gawad, A.; Emara, S.; Farah, M. Y.** (Atomic Energy Establishment, Cairo). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/63(C), 10p. (CONF-651202-32). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Further studies in the UAR program on the feasibility of ground disposal of radioactive wastes are reported. New clays from the Nile and Méadi have been studied as well as those of Mokattam and Ainai. Their eventual domestication was demonstrated for long-lived isotopes as exemplified by ^{90}Sr. The effects of competing ions and heat treatment of clays was particularly emphasized, and an interpretation is proposed for the reported behavior. Further studies are being carried out for cesium on some deep mineralizations at Inshas and Borg el Arab reactor sites. (B.L.M.)

20351 A REVIEW OF RESEARCH AND DEVELOPMENT FOR TREATMENT OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTES. **Thomas, K. T.** (Atomic Energy Establishment, Trombay, India). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/63(A), 12p. (CONF-651202-44). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

This paper summarizes and reviews the work being done in connection with the treatment and disposal of low and intermediate level radioactive effluents. The following aspects of the waste disposal problem are briefly summarized: chemical treatment; ion exchange; foam separation; atomization suspension technique; evaporation; disposal of TBP/diluent wastes; fixation in concrete, asphalt, or other solid media, and gas cleaning studies. In all aspects, the emphasis is on using materials locally available in India for the processing. (B.L.M.)

20352 REVIEW OF NEW DEVELOPMENTS IN THE FIELD OF LOW AND INTERMEDIATE RADIOACTIVE WASTE DISPOSAL IN THE REPUBLIC OF SOUTH AFRICA. **Barbour, R. A.** (South African Atomic Energy Board, Pelindaba). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-71/63(B), 9p. (CONF-651202-10). ORAU.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

A very general description of all the waste processing and disposal facilities at Pelindaba, South Africa is presented. The treatment of all levels of solid and liquid wastes is described. (B.L.M.)

GENERAL AND MISCELLANEOUS

20353 (AD-611869) PROCEEDINGS OF THE 1964 ARMY SCIENCE CONFERENCE, UNITED STATES MILITARY ACADEMY, WEST POINT, N. Y., 17-19 JUNE 1964. VOLUME II. (PRINCIPAL AUTHORS I THRU Z). (Office, Chief of Research and Development (Army), Washington, D. C.). 527p. (CONF-640630(Vol.II)). CFSTI $8.35 cy, $2.25 mn.

Separate abstracts were prepared on two papers. One paper was abstracted previously and appeared in NSA Vol. 19 as No. 37184. Other papers report the results of varied research performed at Army research laboratories. (C.H.)

For abstracts of individual papers see: 18283 and 18503.

20354 (BNL-929) ANNUAL REPORT, JULY 1, 1965. (Brookhaven National Lab., Upton, N. Y.). Nov. 1965. Contract AT(30-2)-Gen-16. 249p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Research and development activities are summarized in eight sections. A separate abstract was prepared for each section. Information included in the report for which no abstract was prepared concerns laboratory supporting activities and laboratory publications. (J.R.D.)

For abstracts of individual papers see: 18184, 18185, 18556, 18988, 19169, 19273, 19285, and 20177.

20355 (BNWL-113-12) PLUTONIUM ABSTRACTS. Volume 5, Number 12. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 31, 1966. Contract AT(45-1)-1830. 39p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

References (79) are given to reports, books, and journals published from 1964 through Jan. 1966. Categories covered include: biology and medicine; chemistry; health and safety; metallurgy and ceramics; physics; and reactor technology. (P.C.H.)

20356 (BNWL-113-13) PLUTONIUM ABSTRACTS. Volume 6, Number 1. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 28, 1966. Contract AT(45-1)-1830. 37p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

References (81) are given to journals and reports published from 1963 through Feb. 1966. Categories covered include: biology and medicine; chemistry; health and safety; metallurgy and ceramics; physics; and reactor technology. (P.C.H.)

20357 (IS-1225) DIAN—A SYSTEM FOR PROGRAMMING A DIGITAL COMPUTER IN TERMS OF ANALOG COMPONENTS. Farris, G. J.; Burkhart, L. E. (Ames Lab., Iowa State Univ. of Science and Tech.). Jan. 1966. Contract W-7405-eng-82. 84p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

DIAN (DIgital-ANalog) is a programming system by which a digital computer may be programmed in a manner very similar to the technique of programming an analog computer. The system is compatible with the Fortran symbolic language and may be used as part of a larger digital computer program. It may be applied to the more general types of boundary-value problems arising in process simulation, to the initial value problems ordinarily solved on analog computers, to non-linear problems, and to control problems involving large transport delays. The system may be used to simulate a very large analog computer or it may be considered to be a separate technique of problem solution with its own unique features. (auth)

20358 (JAERI-5014) ACTIVITIES IN THE DIVISION OF HEALTH PHYSICS, APRIL 1, 1964-MARCH 31, 1965. (Japan Atomic Energy Research Inst., Tokyo). 187p. (In Japanese). Dep. mn.

Research and development progress is reported in sections on radiation control, meteorological and oceanographical surveys and observations, and health physics. Papers and internal reports are listed. (J.R.D.)

20359 (NYO-2973-1) A STUDY OF THE PHYSICAL PROCESSES OF MOVEMENT AND DISPERSION IN THE CAPE KENNEDY AREA. Final Report. Carter, H. H.; Okubo, Akira (Chesapeake Bay Inst., Johns Hopkins Univ., Baltimore, Md.). Mar. 1965. Contract AT(30-1)-2973. 174p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

The fluorescent dye tracer technique used for determining physical processes of movement and dispersion in the coastal waters off Cape Kennedy is described and results are discussed. The Banana and Indian Rivers, Mosquito Lagoon (inshore areas), and the surf zone a few hundred yards off False Cape were also included in the study. The simplest theoretical model consistent with the experimental evidence is also presented. (P.C.H.)

20360 (PRNC-73) ANNUAL REPORT, 1964. (Puerto Rico Nuclear Center, Mayaguez. Puerto Rico Nuclear Center, Rio Piedras). Contract AT(40-1)-1833. 228p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Research efforts devoted to nuclear engineering, health physics, reactors, agricultural bio-sciences, radioisotope applications, radiotherapy and cancer, clinical radioisotope applications, and radiobiology are summarized. Work in a program to measure trace element movements in marine ecological systems is described along with research on terrestrial ecology, and mechanisms of antigen-antibody reactions in mice. Research is also reported on radiation chemistry and photochemistry, resonance in radiation effects, radiation effects on paramutation, neutron diffraction, and radiation effects on organic crystals. (J.R.D.)

20361 (SC-RR-66-41) PROBABILITY DISTRIBUTIONS OF LATITUDES OF REENTRY AND IMPACT FOLLOWING DECAY OF POLAR ORBITS. Edrington, T. S. (Sandia Corp., Albuquerque, N. Mex.). Mar. 1966. Contract AT(29-1)-789. 31p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The differential equations of orbital decay are developed and solved with an analog computer. A large number of solutions are used to derive a probability distribution of re-entry latitude. Re-entry range is determined as a function of re-entry latitude and used with the probability distribution of re-entry latitude to derive a probability distribution of impact latitude. (auth)

20362 (SCL-DC-65-112) THE AUTOMATIC, ADAPTIVE, SERVO CONTROL FOR STOCHASTIC PROCESSES. Hillyer, D. F. Jr. (Sandia Corp., Albuquerque, N. Mex.). Feb. 1966. Contract AT(29-1)-789. 42p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A short, development history of the design of equalization systems is supplied to acquaint the reader with simulation equipment; with automatic, feedback-control concepts; and with the need for greater control accuracy. The relative advantages and disadvantages of three existing types of systems are discussed. A description of an experimental, 3-channel system designed by Technical Products Company, Los Angeles, California, to Sandia Corporation, Livermore Laboratory specifications is followed by a specific example of its use in an equalization process. A detailed account of the theory, method, and results of tests of the randomness and stationarity characteristics of the existing and experimental automatic-equalization systems is presented. (auth)

20363 THE ROLE OF NUCLEAR POWER IN THE TECHNICAL REVOLUTION. Fuchs, K.; Naumann, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie, 8: 664-7(Dec. 1965). (In German).

Three phases of the technical revolution are distin-

guished, which respectively are characterized by the introduction of complex research programs into the production process, the transition to cybernetic methods, and the utilization of abundant resources of energy. The first phase started in the chemical industry, the second phase was stimulated by nuclear energy and governs at present the development of the leading industries. In the third phase the process of automatization will extend over the whole industry. The role of nuclear energy in this process of historical development is discussed. (auth)

20364 FUNDAMENTAL NUCLEAR ENERGY RESEARCH. A Supplemental Report to the Annual Report to Congress for 1965. Washington, D. C., U. S. Atomic Energy Commission, 1965. 338p. GPO $2.25.

Research and development activities are summarized in three parts. Separate abstracts were prepared for these parts. (J.R.D.)

For abstracts of individual parts see: 18198, 20183, and 20365.

20365 BASIC PHYSICAL RESEARCH PROGRAM. pp 217-304 of Fundamental Nuclear Energy Research. Washington, D. C., U. S. Atomic Energy Commission, 1965.

Research summaries are presented on high-energy physics, low-energy physics, mathematics and computers, chemistry, metallurgy and materials, and controlled thermonuclear research. (J.R.D.)

20366 INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT FOURTH ANNUAL MEETING, JUNE 17, 18, 19, 1963, BUFFALO, NEW YORK. Columbus, Ohio, Inst. of Nuclear Materials Management, 1963. 81p. $5.00. (CONF-80).

Proceedings of the Fourth Annual Meeting of the Institute of Nuclear Materials Management are presented. Topics covered include: special nuclear material lease agreement, nondestructive testing in control of special nuclear materials, activities of N-2 committee of American Standards Association, reducing shipper-receiver differences, changes in Title 10 code of federal regulations, reactor operator's approach to nuclear materials management, statistical quality control in the manufacture of reactor fuel elements, nuclear materials and fuel management program for Dresden nuclear power station, data sources for nuclear materials management, effect of Stanford Research Institute study and of private ownership on nuclear materials management, uranium and plutonium accountability procedures for chemical processing of irradiated reactor fuels, and standard practices for nuclear materials. Three papers were previously abstracted for NSA and appeared as 17: 34106, 35167, and 18: 11418. (M.C.G.)

20367 UTILISATIONS DE L'ENERGIE NUCLEAIRE (ASPECTS SCIENTIFIQUES, TECHNIQUES ET HUMAINS). IRRADIATION NATURELLE ET IRRADIATION ARTIFICIELLE DE L'HOMME. QUINZAINE DES SCIENCES NUCLEAIRES. MONTPELLIER, FRANCE, MARS–AVRIL 1962. (Utilization of Nuclear Energy (Scientific, Technical, and Human Aspects). Natural Irradiation and Artificial Irradiation of Man. Fortnight of Nuclear Sciences. Montpellier, France, March–April 1962). Paris, Masson and Cie, [1963]. 646p. (CONF-620303).

A very complete review is presented of the different possibilities offered by ionizing radiation. The topics discussed include uses of nuclear techniques in agriculture, nuclear techniques and instruction, utilization of nuclear techniques in industry, utilizations of nuclear techniques in medicine and pharmacology, industrial hygiene and radioprotection, nuclear careers, and human and social problems. Original studies on the effects of natural and artificial irradiation on man are presented. The eight papers and the discussions following them are compiled. The topics considered are natural irradiation by cosmic rays and the products of cosmic origin, natural irradiation by radioactive contamination, professional irradiation, medical irradiation of man, irradiation following radioactive fallout, non-professional irradiation in connection with radioactive wastes, and general balance of the irradiation of man. (77 references) (J.S.R.)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

AERO VAC CORP., TROY, N. Y.
Prog. rpt. on effect of inert gas flush on O–Nb reaction, 12/64, 20: 19190 (N-65-22168)

AEROJET-GENERAL NUCLEONICS, SAN RAMON, CALIF.
Army gas-cooled reactor systems, ML-1A shield optimization, 20: 20227 (AGN-TM-412)

AIR FORCE WEAPONS LAB., KIRTLAND AFB, N. MEX.
PPA—computer program for photo-peak analysis, 20: 19014 (AD-616703)

AKADEMIYA NAUK SSSR, MOSCOW. INSTITUT FIZICHESKIKH PROBLEM.
Fission of ^{236}U during quadrupole absorption of γ quanta, 20: 19830 (NP-15055)

AKTIEBOLAGET ATOMENERGI, STOCKHOLM (SWEDEN).
Characteristics of linear MHD generators with one or a few loads, 20: 19414 (AE-214)
Measured and predicted neutron flux distributions in a material surrounding a cylindrical duct, 20: 20092 (AE-220)
Neutron scattering in hydrogeneous moderators, 20: 19776 (AE-223)

ALLIS-CHALMERS MFG. CO., BETHESDA, MD. ATOMIC ENERGY DIV.
Conceptual design of large sodium valves, 20: 20184 (ACNP-65579)

ALLIS-CHALMERS MFG. CO., MILWAUKEE, WIS. ATOMIC ENERGY DIV.
Air Force Nuclear Engineering Test Facility Safeguards Report, 20: 20306 (ACNP-62599(Vol.1))
Air Force Nuclear Engineering Test Facility Safeguards Report, 20: 20307 (ACNP-62599(Vol..2))

ALLIS-CHALMERS MFG. CO., WASHINGTON, D. C. NUCLEAR POWER DEPT.
Review of loss of services in EGCR, 20: 20247 (TID-22694)
Thermodynamic properties of uranium, molybdenum, iron, and zirconium at high temperatures and pressures, 20: 19217 (NP-15933)

ALLISON DIV., GENERAL MOTORS CORP., INDIANAPOLIS, IND.
Prog. rpt. on plasma properties, 8/11–11/10/64, 20: 20010 (N-65-23211)

AMERICAN SCIENCE AND ENGINEERING, INC., CAMBRIDGE, MASS.
X-ray telescope, 20: 19030 (N-65-17266)

AMES LAB., IOWA STATE UNIV. OF SCIENCE AND TECH.
DIAN—system for programing digital computer, 20: 20357 (IS-1225)
Effect of ^{58m}Co isomeric transition in tris(ethylenediamine)cobalt(III) nitrate, 20: 18725 (IS-T-73)
Electron correlation, pair approximation and augmented pair expansion. Application to Be-like atomic systems, 20: 19357 (IS-T-64)
Photonuclear yields and cross sections for $^{16}O(\gamma,\alpha n)^{11}C$ reaction, 20: 19819 (IS-T-45)
Retention of ^{126}I following photonuclear activation in KIO_3, 20: 18726 (IS-T-74)
$^{141}Pr(\gamma,n)^{140}Pr$ cross section in the giant resonance region, 20: 19820 (IS-T-78)

AMHERST COLL., MASS. DEPT. OF PHYSICS.
Some thoughts on gases dissolved in the oceans, 20: 18632 (NYO-3450-1, pp 91-107)

ANDREWS UNIV., BERRIEN SPRINGS, MICH.
Young's modulus of lithium between 10 and 300°K, 20: 19221 (TID-21670)

ARGONNE CANCER RESEARCH HOSPITAL, CHICAGO, ILL.
Advances in supervoltage treatment planning, 20: 18423 (ACRH-24, pp 125-34)
Prog. rpt., semiannual, 9/65, 20: 18422 (ACRH-24)

ARGONNE NATIONAL LAB., ILL.
Case-Witwatersrand underground neutrino program, 20: 19408 (ANL-7130, pp 373-92)
Conference on weak interactions, Argonne National Lab., 10/65, 20: 19426 (ANL-7130)
Cosmic-ray neutrinos, 20: 19409 (ANL-7130, pp 393-405)
Decay $K_2^0 \rightarrow \pi^+\pi^-\pi^0$, 20: 19430 (ANL-7130, pp 67-75)
Diffusion in gamma uranium, 20: 19175 (ANL-6568)
Energy dependence of the vector form factor in the K_{e3}^0 decay, 20: 19432 (ANL-7130, pp 83-90)
Engineering development of fluid-bed fluoride volatility processes, Pt. 9, 20: 18820 (ANL-6992)
Experimental status of CP violation, 20: 19428 (ANL-7130, pp 17-28)
Experimental techniques and facilities, 20: 19018 (ANL-7110, pp 231-310)
Fast reactors, 20: 20229 (ANL-7110, pp 99-229)
Fission properties and cross section data, 20: 19805 (ANL-7110, pp 1-28)
General reactor physics, 20: 20201 (ANL-7110, pp 311-401)
High-energy neutrino experiments at accelerators, 20: 19439 (ANL-7130, pp 273-84)
Indication of parity mixing in an electromagnetic transition, 20: 19807 (ANL-7130, pp 333-6)
$K_{3\pi}$ branching ratio, 20: 19434 (ANL-7130, pp 107-13)
K_1–K_2 mass difference and K_2^0 regeneration, 20: 19437 (ANL-7130, pp 215-30)
Laboratory investigations in support of fluid-bed fluoride volatility processes. IX., 20: 18821 (ANL-7077)
Measurement of rate of K_2^0 decay into three pions and test of CP invariance, 20: 19429 (ANL-7130, pp 59-66)
Momentum dependence of the helicity of beta particles, 20: 19806 (ANL-7130, pp 313-25)
ν and $\bar{\nu}$ interactions in a heavy liquid bubble chamber, 20: 19438 (ANL-7130, pp 257-71)
Preliminary results on the charged decay modes of K_2^0, 20: 19431 (ANL-7130, pp 77-81)
Prog. rpt. on reactor physics, annual, 7/64–6/65, 20: 20176 (ANL-7110)
Renormalization of weak axial-vector-coupling constants, 20: 19808 (ANL-7130, pp 409-20)
Selection rules in leptonic decay, 20: 19436 (ANL-7130, pp 159-88)
Spark chamber measurement of the $K_{\mu3}^0$ decay spectrum, 20: 19433 (ANL-7130, pp 91-105)
Thermal reactors, 20: 20200 (ANL-7110, pp 29-98)
Time distribution of K^0 leptonic decays, 20: 19435 (ANL-7130, pp 153-7)
Time reversal invariance in $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$, 20: 19427 (ANL-7130, pp 13-16)
Vibratory grinding and polishing of metallographic specimens, 20: 19176 (ANL-6975)
Weak interactions of non-strange particles, 20: 19440 (ANL-7130, pp 337-71)

ARIZONA UNIV., TUCSON. DEPT. OF NUCLEAR ENGINEERING.
Prog. rpt. on application automatic control theory to nuclear rocket

dynamics and control, semiannual, 9/64–2/65. Il., 20: 20296 (N-65-21462)

ARMA DIV., AMERICAN BOSCH ARMA CORP., GARDEN CITY, N. Y.
Neutron radiation effects on micro circuit digital gates, 20: 19100 (N-65-18004)

ARMY BIOLOGICAL LABS., FREDERICK, MD. PHYSICAL DEFENSE DIV.
Microbial contamination inside irradiated and heated electronic components, 20: 18993 (N-65-24356)

ARMY ELECTRONICS COMMAND, FORT MONMOUTH, N. J.
Use of MOS transistors in solid-state radiation survey meters, 20: 19016 (AD-629709)

ARMY NATICK LABS., MASS.
Radiation biodosimetry and screening for radioprotective compounds, 20: 18503 (AD-611869, pp 169-83)

ATOMENERGIKOMMISSIONEN, RISOE (DENMARK). FORSOEGSINSTITUT.
Bridge for concentration measurement, 20: 18573 (RISO-120)
Instrumentation and control of power plants, 20: 20246 (RISO-M-312)
Numerical analysis of critical neutron scattering data, 20: 19785 (RISO-118)
On-line analog computer for ESR spectrometer, 20: 19039 (RISO-M-233)
Regulation of a PRWR power station, 20: 20245 (RISO-M-241)

ATOMIC ENERGY CENTRE, DACCA (PAKISTAN).
Energy calibration of the Dacca Van de Graaff accelerator, 20: 19284 (AECD-EP-8)

ATOMIC ENERGY COMMISSION, WASHINGTON, D. C.
Fundamental nuclear energy research, 20: 20364

ATOMIC ENERGY ESTABLISHMENT, INSHAS (EGYPT).
Attempt to correlate quantitatively the changes in permeability of mammalian muscle cells with radiation doses, 20: 18293 (NP-14898)

ATOMIC ENERGY ESTABLISHMENT, WINFRITH (ENGLAND).
Buckling and reaction rate measurements in graphite moderated lattices fueled with PuO_2–UO_2 clusters, 20: 20197 (AEEW-R-438)
Comparison of measurements on PuO_2–UO_2 fueled graphite lattices with calculations using the ARGOSY method, 20: 20199 (AEEW-R-466)
Detecting the onset of burnout in rod clusters, 20: 18859 (AEEW-R-432)
Digital computer code for solution of sets of first order differential equations and the analysis of process plant dynamics, 20: 20287 (AEEW-R-453)
Doppler coefficient measurements in ZEBRA core 5, 20: 20310 (AEEW-R-465)
Further buckling measurements on a heated graphite lattice fueled with PuO_2/UO_2 clusters, 20: 20198 (AEEW-R-464)
Reactor perturbation calculations by Monte Carlo methods, 20: 20196 (AEEW-M-581)
SALAMANDER—FORTRAN program for reactor fuel cycle calculations, 20: 20226 (AEEW-R-260)

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO).
Area gamma monitor with automatic range changing, 20: 19017 (AECL-2533)
CANDU booster rod experiment in ZED-2, 20: 20225 (AECL-2525)
Equation for creep of cold-worked Zy-2 pressure tube material, 20: 19203 (AECL-2528)
X-ray spectrographic determinstion of some metal oxide additives in UO_2 and ThO_2, 20: 18558 (AECL-2526)

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO). CHALK RIVER NUCLEAR LABS.
Electromagnetic fields associated with initiation of current between parallel perfectly conducting planes, 20: 19272 (AECL-2531)

ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON (ENGLAND).
RSKF—reactor kinetics code for IBM 7030, 20: 20202 (AWRE-O-4/66)
System for driving a metal plate at 1000 m/s, 20: 18879 (AWRE-O-21/66)

ATOMICS INTERNATIONAL, CANOGA PARK, CALIF.
Calculation of slowing-down transfer matrices in spherical harmonics representation, 20: 19784 (NAA-SR-11530)
Criticality study—five percent ^{235}U enriched fuel fabrication, 20: 20228 (AI-Memo-8810(Rev.1))
DTF-II—neutron transport program, 20: 19783 (NAA-SR-10951)
Neutron flux monitoring with Ar gas, 20: 20206 (NAA-SR-11356)
Noise analysis techniques for measuring reactor coolant velocities, 20: 20297 (NAA-SR-11193)
Solid-state neutron detector for SNAP-10A, 20: 20298 (NAA-SR-11762)

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Anisotropy in the migration area in a parallel slab subcritical assembly, 20: 20195 (AAEC/TM-302)
DEMON—program generator for problems involving ordinary differential equations, 20: 19168 (AAEC/E-142)
Laboratory development of the grind-leach process for the H.T.G.C.R. fuel cycle. I., 20: 18819 (AAEC/E-143)

AVCO CORP., TULSA, OKLA.
Prog. rpt. on detectors for low-energy particles and high-energy photons, 4/10–6/10/64, 20: 19032 (N-65-23928)

B

BAILEY METER CO., WICKLIFFE, OHIO.
Improvement of PM-type reactor instrumentation, 20: 20242 (NYO-3379-3)

BATTELLE INSTITUT E. V., FRANKFURT AM MAIN (WEST GERMANY).
Synthesis of ^{14}C-labeled terphenyls, 20: 18803 (EUR-2527.d)

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
Compatibility of UN with potential cladding metals, 20: 19187 (BMI-1760)
Exposure of threshold detector circuit to flash x-ray environment, 20: 19111 (NP-15910)
Prog. rpt. on civilian applications, 1/66, 20: 19177 (BMI-1757)
Prog. rpt. on radiation reliability of electronics, 1–3/64, 20: 19098 (N-65-17953)
Prog. rpt. on radiation reliability of electronics, 7–9/64, 20: 19099 (N-65-17954)

BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB.
Boiling burnout heat fluxes with a 19-rod bundle test section, 20: 18860 (BNWL-206)
Environmental factors relating to large water plants, 20: 20288 (BNWL-SA-596)
Hot-cell studies of calcination of radioactive fuel reprocessing, 20: 20345 (BNWL-SA-569)
Physics design aspects of plutonium recycle, 20: 20231 (BNWL-SA-547)
Plutonium Abstracts, Vol. 5, No. 12, 20: 20355 (BNWL-113-12)
Plutonium Abstracts, Vol. 6, No. 1, 20: 20356 (BNWL-113-13)
Radiation-induced dimensional changes of graphites containing carbon black, 20: 19252 (BNWL-201)
UCOST—code for calculating cost of enriched U, 20: 18822 (BNWL-189)

BENDIX SYSTEMS DIV., BENDIX CORP., ANN ARBOR, MICH.
Prog. rpt. on radiation effects parameters in NAP applications, 7/64, 20: 19107 (N-65-21263)

BETTIS ATOMIC POWER LAB., PITTSBURGH, PA.
Design report for MELBA test in PWR Core-2 blanket, 20: 20270 (WAPD-TM-483)
Monte Carlo methods for calculation of thermal neutron fluxes, 20: 19786 (WAPD-T-1835(Rev.))
MO565: program to solve rectangular magnetic network, 20: 18996 (WAPD-TM-557)
Nuclear data evaluation, 20: 20218 (WAPD-T-1823)

BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Applied mathematics, 20: 19169 (BNL-929, pp 106-11)
Biology, 20: 18184 (BNL-929, pp 115-25)
Boson resonances, 20: 19533 (BNL-9934)
Chemistry, 20: 18556 (BNL-929, pp 66-82)
Comparative therapeutic efficacy of high-versus low-let radiations, 20: 18507 (BNL-100009)
Emittance measurements on AGS preinjector with duoplasmatron ion source, 20: 19287 (BNL-10095)
High-energy accelerators, 20: 19285 (BNL-929, pp 44-57)
Indication of parity mixing in an electromagnetic transition, 20: 19807 (ANL-7130, pp 333-6)
Instrumentation, 20: 18988 (BNL-929, pp 58-66)
Ionization of liquids under radiation, 20: 18724 (BNL-10012)
Measurements of emittance of output beam of AGS duoplasmatron ion source, 20: 19288 (BNL-10096)
Medical research, 20: 18185 (BNL-929, pp 126-47)
Nuclear engineering, 20: 20177 (BNL-929, pp 83-105)
Passage of charged particles through crystal lattices, 20: 20104 (BNL-944)
Phosphate glass process: evaporator studies with simulated Purex wastes, 20: 20344 (BNL-10047)
Physics, 20: 19273 (BNL-929, pp 3-43)
Problems of neutron capture therapy, 20: 18508 (BNL-10038)
Prog. rpt. on activities, annual, 7/65, 20: 20354 (BNL-929)
Randomly packed settled-bed fast reactor concept, 20: 20230 (BNL-887)
Rate and type of blow-up of dense particle beams, 20: 19286 (BNL-10049)

BROWN UNIV., PROVIDENCE, R. I. DEPT. OF PHYSICS.
Prog. rpt. on radiation damage studies in solids, annual, 5/65–4/66, 20: 19256 (NYO-2024-9)

BROWN UNIV., PROVIDENCE, R. I. DIV. OF ENGINEERING.
Some aspects of the fracture of metallic composites, 20: 19218 (NYO-2394-18)

BRUSSELS UNIV. (BELGIUM). INSTITUT JULES BORDET.
Thymectomy and radiocancers, 20: 18286 (EUR-2462.f)

C

CALIFORNIA INST. OF TECH., PASADENA. DIV. OF GEOLOGICAL SCIENCES.

Concentrations of common lead in Greenland snows, 20: 18944 (NYO-3450-1, pp 213-15)

CALIFORNIA INST. OF TECH., PASADENA. SYNCHROTRON LAB.
Angular profile of beam from photographic plate measurements, 20: 19289 (CALT-68-20)
Calibrating phototubes for the pp̄ experiment at Brookhaven, 20: 19019 (CALT-68-27)
Cherenkov light absorption in several samples of lucite, 20: 19021 (CALT-68-53)
General range-energy-light output program for high-energy physics, 20: 19022 (CALT-68-62)
Large spark chamber field lens, 20: 19020 (CALT-68-30)
Manual for the new CW exciter for the linac, 20: 19290 (CALT-68-64)
Re-calibration of beam energy meter, 20: 19291 (CALT-68-67)

CALIFORNIA INST. OF TECH., PASADENA. W. M. KECK LAB. OF ENGINEERING MATERIALS.
Raman scattering in x-rays, 20: 18559 (CALT-221-14)

CALIFORNIA UNIV., BERKELEY.
Dynamic response of dual-heat-exchanger system, 20: 18873 (UCB-34P64-1)

CALIFORNIA UNIV., BERKELEY. DONNER LAB.
Prog. rpt. on biology and medicine, semiannual, fall, 1965, 20: 18190 (UCRL-16613)

CALIFORNIA UNIV., BERKELEY. DONNER PAVILION.
Prog. rpt. on biology and medicine, semiannual, fall, 1965, 20: 18190 (UCRL-16613)

CALIFORNIA UNIV., BERKELEY. SPACE SCIENCES LAB.
Prog. rpt. on kilovolt ion sputtering, 1/31/65, 20: 19358 (N-65-17255)
Prog. rpt. on kilovolt ion sputtering, 4/30/65, 20: 19359 (N-65-24388)

CALIFORNIA UNIV., LOS ANGELES. LAB OF NUCLEAR MEDICINE AND RADIATION BIOLOGY.
Biochemistry, 20: 18210 (UCLA-12-576, pp 15-25)
Biophysics, 20: 18297 (UCLA-12-576, pp 81-8)
Environmental radiation, 20: 18211 (UCLA-12-576, pp 89-111)
Nuclear medicine, 20: 18509 (UCLA-12-576, pp 61-80)
Pharmacology and toxicology, 20: 18296 (UCLA-12-576, pp 57-60)
Prog. rpt. semiannual, 12/65, 20: 18189 (UCLA-12-576)
Radiobiology, 20: 18295 (UCLA-12-576, pp 27-56)

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOILS AND PLANT NUTRITION.
Prog. rpt. on accumulation of Ce, Y, and Cs in plants, 6/65–5/66, 20: 18208 (TID-22715)

CAMBRIDGE ELECTRON ACCELERATOR, MASS.
Revision of shielding calculations, 20: 19305 (TID-22772)

CANADIAN GENERAL ELECTRIC CO. LTD., PETERBOROUGH (ONTARIO). CIVILIAN ATOMIC POWER DEPT.
Heat transfer failure mechanisms in simulated organic-cooled fuel bundles, 20: 20189 (R64CAP10)
Main shield for Whiteshell Reactor No. 1, 20: 20308 (AECL-2544)
Preliminary report on an HWR plant for electric power and water desalination, 20: 20290 (NP-15920)
Secondary shield design for Whiteshell Reactor No. 1, 20: 20309 (AECL-2545)

CARNEGIE INST. OF TECH., PITTSBURGH, PA.
Prog. rpt. on radiation chemistry, final, 4–8/65, 20: 18729 (NYO-2007-9)

CARNEGIE INST. OF TECH., PITTSBURGH, PA. METALS RESEARCH LAB.
Prog. rpt. on study of interaction between point defects and dislocations through damping experiments, 5/65–1/66, 20: 20113 (NYO-3001-1)

CASE INST. OF TECH., CLEVELAND, OHIO.
Case-Witwatersrand underground neutrino program, 20: 19408 (ANL-7130, pp 373-92)

CASE INST. OF TECH., CLEVELAND, OHIO. DEPT. OF PHYSICS.
Transport properties of turbulent Lorentz gas, 20: 19615 (N-65-19888)

CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE, MOL (BELGIUM).
Exchange adsorption of ions from acid solutions on inorganic ion exchanger, 20: 18564 (EUR-2748.e)
Prog. rpt. on reprocessing of irradiated fuels, 4–6/65, 20: 18824 (EURAEC-1536)

CHESAPEAKE BAY INST., JOHNS HOPKINS UNIV., BALTIMORE, MD.
Physical processes of movement and dispersion in Cape Kennedy area, 20: 20359 (NYO-2973-1)

CHICAGO UNIV., ILL.
Weak interactions of non-strange particles, 20: 19440 (ANL-7130, pp 337-71)

CHICAGO UNIV., ILL. INST. FOR COMPUTER RESEARCH.
Prog. rpt. on computer research, 2/66, 20: 19171 (COO-614-43)

COLUMBIA UNIV., NEW YORK.
Time reversal invariance in $\Sigma^0 \to \Lambda^0 + e^+ + e^-$, 20: 19427 (ANL-7130, pp 13-16)

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Capillary properties of alkali metal systems. I. and II., 20: 18624 (CU-2660-24)

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Radiogenic leads of the Canadian and Baltic shield regions, 20: 18894 (NYO-3450-1, pp 169-84)
Some thoughts on gases dissolved in the oceans, 20: 18632 (NYO-3450-1, pp 91-107)
Sulfur isotopes in the marine environment, 20: 18893 (NYO-3450-1, pp 131-48)
Trace element economy in the oceans, 20: 18892 (NYO-3450-1, pp 41-89)
ROCHESTER UNIV., N. Y. DEPT. OF PHYSICS AND ASTRONOMY.
Applications of the algebra of currents, 20: 19541 (UR-875-121)
Contributions to Williamsburg conference on intermediate-energy physics, 20: 19450 (UR-875-126)
Measurement of lifetime of the positive pion, 20: 19451 (UR-875-126, Paper 3)
Neutron-proton interactions at 205 Mev, 20: 19453 (UR-875-126, Paper 5)
Nucleon-nucleon bremsstrahlung at 200 Mev, 20: 19452 (UR-875-126, Paper 4)
Production of A_1, A_2, and B mesons in high-energy $\pi^{\pm}$ p interactions, 20: 19449 (UR-875-123 and (Add.))
Theory of pion absorption on light nuclei, 20: 19843 (UR-875-126, Paper 2)
Two-nucleon emission following absorption of stopped negative pions, 20: 19842 (UR-875-126, Paper 1)
ROCKY FLATS DIV., DOW CHEMICAL CO., GOLDEN, COLO.
Dry box glove testing and evaluation, 20: 18947 (RFP-343)
Liquid media for density measurements of Be, Pu, and U, 20: 19219 (RFP-691)
Plutonium management at Rocky Flats, 20: 18948 (RFP-720)
RUTGERS–THE STATE UNIV. OF NEW JERSEY, NEW BRUNSWICK. BUREAU OF ENGINEERING RESEARCH.
Motion of small particles in non-uniform temperature fields, 20: 18868 (NYO-2930-5)
RUTGERS UNIV., NEW BRUNSWICK, N. J.
Decay $K_2^0 \rightarrow \pi^+\pi^-\pi^0$, 20: 19430 (ANL-7130, pp 67-75)

S

SAINT LOUIS UNIV., MO.
Prog. rpt. on effects of weightlessness and radiation on hibernators, 6/63, 20: 18291 (N-65-17058)
SANDIA CORP., ALBUQUERQUE, N. MEX.
Aerospace nuclear safety, 20: 18949 (SC-DC-66-1369)
Air-blast yield scaling in refracting atmospheres, 20: 19618 (SC-RR-65-369)
Automatic, adaptive, servo control for stochastic processes, 20: 20362 (SCL-DC-65-112)
Chemical integrity of radioisotope containment materials in launch abort environments, 20: 19192 (SC-DC-65-1918)
Controlled deorbit, 20: 20302 (SC-RR-65-472)
Dynamic three-dimensional atmospheric model for use in study of selectivity of orbital decay, 20: 19646 (SC-DC-65-1701)
Probability distributions of latitudes of reentry and impact following decay of polar orbits, 20: 20361 (SC-RR-66-41)
SANDIA CORP., LIVERMORE, CALIF.
Dynamic response of long cylindrical shell to thermal loading, 20: 18852 (SCL-DR-65-144)
SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIF.
Concentrations of common lead in Greenland snows, 20: 18944 (NYO-3450-1, pp 213-15)
Isotopic oceanography: deuterium and ^{18}O variations in the ocean and the marine atmosphere, 20: 18896 (NYO-3450-1, pp 277-374)
Radiogenic leads of the Canadian and Baltic shield regions, 20: 18894 (NYO-3450-1, pp 169-84)
SETON HALL UNIV., SOUTH ORANGE, N. J.
Explicit solution of the analytic n-body problem, 20: 19274 (N-65-16830)
SOCIETA RICERCHE IMPIANTI NUCLEARI, SLUGGIA (ITALY). CENTRO RICERCHE NUCLEARI.
Production of radioelements and labeled molecules for medical use in Italy, 20: 18804 (SORIN-34)
SOCIETE PROGIL, LYON (FRANCE). LABORATOIRE CENTRAL DE RECHERCHES.
Determination of the composition, up to and including hexaphenyls, of polyphenyls which have been subjected to pyrolysis and/or radiolysis, 20: 18560 (EUR-2454.f)
SOUTHERN METHODIST UNIV., DALLAS, TEX.
Prog. rpt. on dosimetry, 2/65, 20: 19031 (N-65-19766)
SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX. DEPT. OF AEROSPACE PROPULSION RESEARCH.
Prog. rpt. on liquid-metal lubricated journal bearings, 11/65–3/66, 20: 18853 (SWRI-1228-8-20)
SPACE TECHNOLOGY LABS., INC., REDONDO BEACH, CALIF.
Charged particle radiation damage in semiconductors. X., 20: 19105 (N-65-19870)
Direct detection of ambient electron plasma oscillation fields in magnetosphere, 20: 19644 (N-65-23933)
STAATLICHE ZENTRALE FUER STRAHLENSCHUTZ, BERLIN (EAST GERMANY).

Biological-chemical radiation protection, 20: 18428 (SZS-11(1965))
Determination of thorium in urine, 20: 18805 (SZS-12(1965))

STANFORD LINEAR ACCELERATOR CENTER, STANFORD UNIV., CALIF.
Magnetic characteristics of accelerator quadrupole triplets, 20: 19304 (SLAC-55)
Renormalization of weak axial-vector-coupling constants, 20: 19808 (ANL-7130, pp 409-20)
2-Meter spark chamber magnet model for determination of field distribution in space, 20: 19041 (SLAC-57)

STANFORD RESEARCH INST., MENLO PARK, CALIF.
Radiological target analysis procedures, 20: 18938 (AD-629784)
Vapor pressure and enthalpy of vaporization of molten $HgCl_2$ to critical point, 20: 18634 (SRIA-106-37)

STANFORD UNIV., CALIF.
Stochastic difference equations occurring in one-compartment models, 20: 18427 (ORNL-3920)

STANFORD UNIV., CALIF. DEPT. OF PHYSICS.
Prog. rpt. on threshold effects in nuclear reactions, final, 11/62–1/66, 20: 19802 (AD-630042)

STANFORD UNIV., CALIF. MICROWAVE LAB.
Low-frequency impedance characteristics of Langmuir probe in a plasma, 20: 20007 (N-65-22196)

STANFORD UNIV., CALIF. STANFORD ELECTRONICS LABS.
Correlation between auroral, magnetic, and ELF phenomena at Byrd Station, Antarctica, 20: 19641 (N-65-21748)

STATE UNIV. OF IOWA, IOWA CITY. DEPT. OF PHYSICS AND ASTRONOMY.
Adiabatic motions of charged particles in dipole model of magnetosphere, 20: 19640 (N-65-21332)
Prog. rpt. on Mariner C-64, final, 5/17/63–12/30/64, 20: 19034 (N-65-27827)

STEVENS INST. OF TECH., HOBOKEN, N. J. DEPT. OF PHYSICS.
Cross-field diffusion of quiescent potassium magnetoplasmas, 20: 20016 (NYO-2813-35)
Prog. rpt. on plasma physics, annual, 2/66, 20: 20017 (NYO-2813-36)

SUFFIELD EXPERIMENTAL STATION, RALSTON (ALBERTA).
Precursor shocks produced by a large-yield TNT explosion, 20: 18923 20: 18923 (N-65-22654)

SYDNEY UNIV. (AUSTRALIA). SCHOOL OF PHYSICS.
Laboratory simulation of magnetic fields produced in the moon by trapped field of solar plasma stream, 20: 19328 (NP-15939)
Magneto-Kerr effect at plasma surface, 20: 20014 (NP-15938)
Prog. rpt., semi-annual, 7–12/65, 20: 20015 (NP-15940)

T

TECHNISCHE HOGESCHOOL, EINDHOVEN (NETHERLANDS).
Application of acoustical methods for determining void fractions in boiling water systems, 20: 20187 (EURAEC-1361)
Theoretical study on two-phase flow characteristics, 20: 18863 (EURAEC-1360)

TENNESSEE UNIV., KNOXVILLE.
Electron capture cross sections and negative ion lifetimes, 20: 18557 (ORNL-TM-1409)
Properties of V_K centers in KI, 20: 20115 (ORNL-TM-1422)

TENNESSEE VALLEY AUTHORITY, OAK RIDGE.
Accident consequences following ejection of control rod from the EGCR core, 20: 20254 (TID-22743)
Calculation of combined temperature coefficient of reactivity for EGCR, 20: 20253 (TID-22742)
Computer study of rate-of-change, of-pressure scram system, 20: 20261 (TID-22754)
Containment vessel electrical penetrations—study of periodic test methods, 20: 20266 (TID-22770)
Disturbances in EGCR core, 20: 20259 (TID-22749)
EGCR control rod studies, 20: 20252 (TID-22741)
Hydraulics and heat transfer: BWR, 20: 20263 (TID-22758)
Information provided to operators for use under depressurization accident conditions, 20: 20256 (TID-22745)
Kinetics of positive and negative period measurements in the EGCR, 20: 20265 (TID-22768)
Levitation of an EGCR control rod, 20: 20250 (TID-22739)
Nuclear power reactor siting, 20: 20255 (TID-22755)
Procedure for determining depressurization rate of the EGCR primary system in the event of component failure, 20: 20251 (TID-22740)
Proposals for EGCR reactor kinetics experiments utilizing noise-analysis techniques, 20: 20260 (TID-22753)
Reactor coolant system rate-of-change-of-pressure (dp/dt) trip, 20: 20264 (TID-22760)
Structural adequacy of EGCR steam generators during primary system depressurization accident, 20: 20258 (TID-22748)
Summary of accident conditions investigated in determining maximum credible accident for the EGCR, 20: 20257 (TID-22746)
Summary of design of EGCR coolant system, 20: 20249 (TID-22738)
Transient calculations for the EGCR base case accident, 20: 20262 (TID-22755)

TEXAS AGRICULTURAL AND MECHANICAL COLL., COLLEGE STATION. DEPT. OF OCEANOGRAPHY AND METEOROLOGY.
Prog. rpt. on chemistry and analysis of trace metals in sea water, annual, 8/61–11/62, 20: 18576 (TID-22660)

TEXAS AGRICULTURAL AND MECHANICAL UNIV., COLLEGE STATION, DEPT. OF OCEANOGRAPHY AND METEOROLOGY.
Distribution of gamma emitting radionuclides in the Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)

THAYER SCHOOL OF ENGINEERING, DARTMOUTH COLL., HANOVER, N. H.
Prog. rpt. on two-phase flow and boiling heat transfer, 9/65, 20: 18869 (NYO-3114-10)

THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND, OHIO.
Forced-circulation, Croloy 9M, Hg loop to study corrosion product separation, 20: 19189 (N-65-21161)

THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND, OHIO. NEW PRODUCT RESEARCH DEPT.
Prog. rpt. on ion engine system, final, 3/3–12/14/64, 20: 18884 (N-65-22975)

TRG, INC., SYOSSET, N. Y.
Effect of shield splitting and placement in nuclear-propelled space vehicles, 20: 20093 (N-65-22849)

TRW SPACE TECHNOLOGY LABS., THOMPSON RAMO WOOLDRIDGE INC., REDONDO BEACH, CALIF.
Final rpt. on ion beam diagnostics, 4/15/65, 20: 20009 (N-65-22617)

TRW SYSTEMS, REDONDO BEACH, CALIF.
Chemical integrity of radioisotope containment materials in launch abort environments, 20: 19192 (SC-DC-65-1918)
Hydrodynamic stability of natural circulation boiling systems, 20: 18871 (STL-372-14(1))

TRW SYSTEMS, REDONDO BEACH, CALIF. APPLIED THERMODYNAMICS DEPT.
Heat conduction criterion for dispersal of molten reactor fuel by transient boiling of coolant, 20: 20180 (STL-372-27, pp 22-35)
High-pressure loop for studies of subcooled boiling, 20: 18872 (STL-372-27, pp 13-21)
In-pile capsule measurements of transient steam-void formation, 20: 20179 (STL-372-27, pp 3-12)
Prog. rpt. on kinetics studies of heterogeneous water reactors, 9/30/65, 20: 20178 (STL-372-27)

TULSA UNIV., OKLA. DEPT. OF CHEMISTRY.
Deposition rates by the protactinium method, 20: 18926 (NYO-3450-1, pp 29-40)

TURIN UNIV. (ITALY). ISTITUTO DI FISICA.
Dispersion corrections to electron scattering in ^{12}C and ^{16}O, 20: 19825 (LAL-1153)

U

UNION CARBIDE CORP., KOKOMO, IND. STELLITE DIV.
Properties of Haynes alloy Cb-753, 20: 19214 (N-65-22097)

UNION CARBIDE CORP., OAK RIDGE, TENN. Y-12 PLANT.
Strain gage techniques and associated tests on pressure vessels and materials, 20: 18880 (Y-KD-5)

UNITED STATES–EURATOM FAST REACTOR EXCHANGE PROGRAM.
Liquid metal reactor cooling systems, 20: 20237 (EURFNR-42F)

UNITED STATES–EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM.
Carryunder sources in radial vane separator, 20: 18864 (GEAP-4935)
Compatibility of UN with potential cladding metals, 20: 19187 (BMI-1760)
Prog. rpt. on burnable poison additions to UO_2, 10–12/65, 20: 19253 (CEND-3107-261)
Prog. rpt. on effect of substructure on irradiation stability of ASTM A302 grade B steel, 1/66, 20: 19205 (GA-6923)
Prog. rpt. on reprocessing of irradiated fuels, 4–6/65, 20: 18824 (EURAEC-1536)
Prog. rpt. on Saxton Pu program, 10–12/65, 20: 20271 (WCAP-3385-6)
Prog. rpt. on stability studies for boiling water reactors; final, 4/64–4/65, 20: 20236 (EURAEC-1561)
Prog. rpt. on two-phase flow and boiling heat transfer, 9/65, 20: 18869 (NYO-3114-10)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA).
Case-Witwatersrand underground neutrino program, 20: 19408 (ANL-7130, pp 373-92)

USTAV JADERNEHO VYZKUMU, CESKOSLOVENSKA AKADEMIE VED, REZ.
Determination of critical size and effective fuel charge of heavy water–

natural uranium reactor with multizone active core, 20: 20267 (UJV-1046)
Effect of neutron irradiation on mechanical properties of 13030 type (Mn Ni Mo Nb) low-alloy steel, 20: 19258 (UJV-1470/65)
Isolation of trace amounts of Sr, 20: 18579 (UJV-1489)
Laboratory extraction equipment for regeneration of irradiated fuel, 20: 18826 (UJV-1441)
Measurements of neutron flux attenuation in reactor biological shielding model, 20: 20269 (UJV-1454/65)
Optimization of reactor active core and restarting time of D_2O–U reactor. II., 20: 20268 (UJV-1422)
Radiolysis of organic binary mixtures from point of view of radiation synthesis, 20: 18730 (UJV-1468)
3^+ Level in ^{186}Re β decay, 20: 19841 (UJV-1456/65)

UT-AEC AGRICULTURAL RESEARCH LAB., OAK RIDGE, TENN.
Prog. rpt. on agricultural research, semiannual, 1–6/65, 20: 18188 (ORO-635)

UTAH UNIV., SALT LAKE CITY.
Cosmic-ray neutrinos, 20: 19409 (ANL-7130, pp 393-405)

V

VANDERBILT UNIV., NASHVILLE, TENN.
Decay $K_2^0 \rightarrow \pi^+\pi^-\pi^0$, 20: 19430 (ANL-7130, pp 67-75)
Prog. rpt. on antiradiation drugs, 10–12/65, 20: 18424 (AD-630199)

W

WALTER REED ARMY INST. OF RESEARCH, WASHINGTON, D. C.
Effects of massive doses of ionizing radiation upon conditioned avoidance behavior of the primate, 20: 18283 (AD-611869, pp 375-89)

WARSAW UNIV. (POLAND). DEPT. OF RADIOCHEMISTRY.
Neutrinos in superdense matter. III., 20: 19446 (NP-15932)
Remarks on motion in gravitational fields of extended masses, 20: 19698 (NP-15931)

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
Distribution at sea of Columbia River water and its load of radionuclides, 20: 18902 (RLO-1725-41)

WESTERN GEAR CORP., LYNWOOD, CALIF. RESEARCH DEPT.
Process development and evaluation of plasma-sprayed beryllium, 20: 19198 (N-65-22107)

WESTERN RESERVE UNIV., CLEVELAND, OHIO.
Beta decay of ^{86}Rb, 20: 19828 (N-65-22126)

WESTINGHOUSE ELECTRIC CORP., LIMA, OHIO. AEROSPACE ELECTRICAL DIV.
Model of 2-kw, 2500-volt power converter for ion thrustors, 20: 18883 (N-65-21432)

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. ASTRO-NUCLEAR LAB.
Changes in the GAM-TNS program and cross section library, 20: 19844 (WANL-TME-1228)

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. ATOMIC POWER DIV.
Critical experiments performed with clustered and uniform arrays of rodded absorbers, 20: 20210 (WCAP-3269-39)
Prog. rpt. on Saxton Pu program, 10–12/65, 20: 20271 (WCAP-3385-6)
Prog. rpt. on Yankee core evaluation, 12/65, 20: 20272 (WCAP-6079)

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.
Factors affecting the distribution of deuterium in the ocean, 20: 18201 (NYO-3450-1, pp 149-68)
Manganese–iron accumulations in shallow marine environment, 20: 18895 (NYO-3450-1, pp 217-76)

Y

YALE UNIV., NEW HAVEN, CONN.
Momentum dependence of the helicity of beta particles, 20: 19806 (ANL-7130, pp 313-25)
Nucleon-nucleon scattering, 20: 19454 (YALE-1807-33)
Selection rules in leptonic decay, 20: 19436 (ANL-7130, pp 159-88)

YALE UNIV., NEW HAVEN, CONN. DEPT. OF GEOLOGY.
Sulfur isotopes in the marine environment, 20: 18893 (NYO-3450-1, pp 131-48)
Trace element economy in the oceans, 20: 18892 (NYO-3450-1, pp 41-89)

Z

ZENTRALINSTITUT FUER KERNFORSCHUNG, ROSSENDORF BEI DRESDEN (EAST GERMANY).
Radiation alarm arrangement for Rossendorf annular zone reactor, 20: 20316 (ZfK-RN-29)
Reactor codes of reactor theory division of the ZfK, 20: 20211 (ZfK-TPh-17)

ZENTRALINSTITUT FUER KERNPHYSIK, ROSSENDORF BEI DRESDEN (EAST GERMANY).
Stability of ion tracks in eccentric acceleration, 20: 19306 (ZfK-PhA-2)

PERSONAL AUTHOR INDEX

Each entry after an author's name is a shortened version of the title of the report or article, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

A

AALAND, K., Saturating pulse transformer with optimized output for a solenoid load, 20: 20019 (UCRL-14511-T(Rev.1))

ABASHIAN, A., Energy dependence of the vector form factor in the $K^{\circ}_{\mu 3}$ decay, 20: 19432 (ANL-7130, pp 83-90)

ABASHIAN, A., Spark chamber measurement of the $K^{\circ}_{\mu 3}$ decay spectrum, 20: 19433 (ANL-7130, pp 91-105)

ABBOTT, W. E., Design features of the modern pressurized water reactor, 20: 20219

ABDEL-MONEM, A., Prog. rpt. on isotope geochemistry, annual, 1965, 20: 18924 (NYO-1669-11)

ABDEL-WAHAB, M. F., Metabolism of zinc in liver cirrhosis using ^{65}Zn, 20: 18222

ABERDAM, Myriam, Liquid metal reactor cooling systems, 20: 20237 (EURFNR-42F)

ABERTH, William, Elastic differential scattering of He^{+} ions by Ne and Ar and of Ar^{+} ions by Ar at 10 to 600 ev, 20: 19392

ABOU-HADID, L. F., Effect of hard core on the A-p scattering cross section, 20: 19475

ABRAMOV, V. A., Radiation of a finite volume of unbalanced plasma, 20: 20034

ABRAMS, R. J., Energy dependence of the vector form factor in the $K^{\circ}_{\mu 3}$ decay, 20: 19432 (ANL-7130, pp 83-90)

ABRAMS, R. J., Spark chamber measurement of the $K^{\circ}_{\mu 3}$ decay spectrum, 20: 19433 (ANL-7130, pp 91-105)

ABRO, Arnold, Effect of x irradiation on spermatogenesis in Drosophila melanogaster, 20: 18310

ABUTALYBOV, I. M., Nuclear magnetic effects in pair formation by γ quanta, 20: 19968

ACCENSI, A., Annihilations of 5.7-Bev/c $\bar{p}$ in hydrogen into four charged pions, 20: 19498

ACETO, Henry Jr., Radiotherapeutic possibilities of negative pions, 20: 18516

ACHE, Hans J., Bond energy effects and acetylene production in the reactions of energetic carbon atoms with alkyl halides and propane, 20: 18714

ACKERMAN, Adolph J., Atomic power plants—what's wrong with them?, 20: 20284

ADACHI, Gin-ya, X-ray fluorescent spectrometric determination of yttrium in solution form, 20: 18611

ADAMOV, I. Yu., Instability of a plasma discharge with oscillating electrons. I., 20: 20082

ADAMOV, I. Yu., Instability of a plasma discharge with oscillating electrons. II., 20: 20083

ADAMS, D. R., Prog. rpt. on controlled environmental radioiodine tests, annual, 1965, 20: 18941 (IDO-12047)

ADAMSKI, L., Measurement of neutron density distributions in multilayer unit cells. I., 20: 20204 (INR-656/IX-A/R)

ADLAM, J. H., Variation of conversion efficiency of NE 102A plastic scintillator with x-ray energy in range 1.8 to 4.5 kev, 20: 19066

ADLER, Stephen L., High-energy semileptonic reactions, 20: 19527

ADNAMS, D. J., Detecting the onset of burnout in rod clusters, 20: 18859 (AEEW-R-432)

ADOLPHE, M., In vivo and tissue culture studies on radioprotective action of organophosphorus compounds, 20: 18482

AGARWAL, B. K., Peripheral model study of $Y^{\dagger}$ in π^{-}-p collisions, 20: 19469

AGARWAL, V. K., Crystal density in supercooled radiation detector, 20: 19073

AGATI, G., Leukopenic effects of cyclophosphamide associated with panir-radiation in rat, 20: 18504

AGEEVA, I. N., Effect of zirconium on mechanical and electrical properties of aluminum, 20: 19241

AGHASSI, J. J., Energy spectrum of de Sitter world theories, 20: 19570

AHMED, Mushtaq, Nuclear interactions produced by 725-Mev/c antiprotons in nuclear emulsions, 20: 19465

AINSWORTH, E. J., Endotoxin protection of mice, 20: 18425 (AD-630338)

AKAMINE, E., Prog. rpt. on disinfestation of fruit and vegetables by gamma irradiation, annual, 6/64–5/65, 20: 19121 (UH-235P5-1)

AKAMINE, Ernest K., Shelf-life extension of papayas with gamma irradiation, 20: 18300 (UH-235P5-1, pp 55-74)

AKASOFU, S.-I., Polar electrojet, 20: 19657

AKIMOV, A. V., Measurement of conductivity of gas discharge plasma by a radiofrequency method, 20: 20088

AKPINAR, S., Cekmece Nuclear Research and Training Center, 20: 20318

AKPINAR, S., Scientific cooperation between Cekmece and BNL, 20: 20343

AKYEAMPONG, D. A., Representations and coupling of the U(6,6) tower, 20: 19535 (IC-66/23)

ALBAREDE, P., Multiple-field collimator for measurement of uptake by the thyroid, 20: 19052

ALBERT, Nolan Jones, Determination of LD_{50} with ^{60}Co of certain species of millipeds, 20: 18366

ALBERTI, G., Stoichiometry of ion exchange materials containing zirconium and phosphate, 20: 18841

ALBISU, F., Installation, operation, and program of ARBI reactor in Bilbao, 20: 20325

ALBU, A. St., Cytochemical and cytospectrophotometric study on the leukocytes of rats exposed to internal irradiation with ^{32}P. III., 20: 18499

ALEKSANDROV, I. D., Correlation of two forms of post-radiation destruction of cells in bone marrow of mice with and without protection by meksamine, 20: 18430

ALEKSANDROV, V. Yu., Effect of heavy water D_2O on resistance of plant and animal cells, cell models and proteins to certain denaturing factors, 20: 18218

ALEKSEEV, V. A., Radiocarbon dates of Lab. of the Geological Inst., USSR, 20: 18931

ALEXANDER, E., Ion distribution in plasma of a vacuum spark, 20: 20025

ALEXANDER, J. M., Continuous monitor for prompt detection of airborne plutonium, 20: 19057

ALEXANDER, P., Role of post-irradiation repair processes in chemical protection and sensitization, 20: 18444

ALEXANDER, F., Sensitization of lymphoma cells to x-rays by 5-bromodeoxyuridine, 20: 18445

ALEXANDER, P., Sensitization of bacteria to x-rays by iodoacetamide and some related compounds, 20: 18446

ALEXANDER, T. K., Lifetimes of 937- and 1082-kev states of ^{18}F, 20: 19918

ALEXEFF, I., Electron-emitting and electron-collecting probes as ion wave detectors, 20: 19012

ALFF, C., Time reversal invariance in $\Sigma^0 \rightarrow \Lambda^0 + e^+ + e^-$, 20: 19427 (ANL-7130, pp 13-16)

ALIAN, A., Solvent extraction studies of the amine nitrate complexes of thorium, uranium, and cerium, 20: 18829

ALISHEV, S. I., Nuclear magnetic effects in pair formation by γ quanta, 20: 19968

ALKHAZNOV, G. D., Maximum resolving power of semiconductor detectors, 20: 19063

ALLAS, R. G., Reaction $^{39}K(p,\alpha)^{36}Ar$, 20: 19902

ALLEN, A. O., Ionization of liquids under radiation, 20: 18724 (BNL-10012)

ALLEN, K. W., Lifetimes of 937- and 1082-kev states of ^{18}F, 20: 19918

ALLEN, L. S., Theory of neutron logging. II., 20: 18932

ALLEN, Peter Sutcliffe, Developments in nuclear magnetic resonance study of molecular motion in solids, 20: 18672

ALLES-BORELLI, V., Annihilations of 5.7-Bev/c $\bar{p}$ in hydrogen into four charged pions, 20: 19498

ALLWEIN, M., Identification of alpha-emitting nuclides in fallout, 20: 18910

ALMELEH, N., Prog. rpt. on radiation damage in Si, 10/15/63–10/15/64, 20: 19102 (N-65-19693)

ALMELEH, N., Prog. rpt. on radiation damage in Si, 10/15/63–4/15/64, 20: 19106 (N-65-19886)

ALPER, Tikvah, Exceptionally small size of scrapie agent, 20: 18314

ALTMANN, H., Charge transfer: a factor of radioresistance, 20: 18245 (SGAE-BL-16/1965)

ALTMANN, H., Sulfur determination in biological materials, 20: 18609

ALTON, G., Doping of silicon by ion implantation, 20: 20123

ALTON, G. D., Special ORNL isotopic preparations, 20: 19153

AMATI, D., Nuclear forces, 20: 19981

AMBEGAOKAR, V., Suppression of strangeness-changing weak currents, 20: 19577

AMEL, S., Triplet at 2.8 Mev in ^{21}Ne, 20: 19909

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AMYOT, L., First flight collision probabilities in pin clusters and rod lattices, 20: 20203 (EUR-2751.e)

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I

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J

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LOVE, L. O., Special ORNL isotopic preparations, 20: 19153
LOVE, L. O., Techniques and feed materials which have improved calutron performance, 20: 19152
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M

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O

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OYA, Akio, Surface diffusion phenomena in gaseous diffusion. III., 20: 19138

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P

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PALMA, V., Selective effects of radioprotectors, 20: 18475

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PARCHEVSKII, V. P., Certain regularities in accumulation of yttrium and strontium by marine organisms, 20: 18215
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PAUL, I. R., Radiation control program, 20: 18966
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PFEIFFER, B., Mixed phases of praseodymium(III) oxide and terbium(III) oxide, 20: 18697
PFEIFFER, E., Superconductivity in ceramic, mixed titanates, 20: 19767
PFEIFFER, L., Simple cooling system with circulating helium gas, 20: 18877
PHILLIPS, R. E., Ion diffusion. III., 20: 18816
PICCOTTI, F., Recovery effect induced by some subcellular fractions against ionizing radiation damage, 20: 18460
PICKETT, J. J., Investigation of beryllium windows from CEA bubble chamber, 20: 19038 (NYO-10742)
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PODESTA, A. M., Radioprotective effects against radiation by nucleoproteins of lyophilized spleen and bone marrow, 20: 18497
PODIO, G., Pharmacological investigations on cyclohexanol succinate (radioplex), 20: 18378
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POHLIT, Wolfgang, Use of different types and qualities of radiation in treatment of disease, 20: 18521
POHLMANN, H.-P., Separation of zirconium and hafnium by liquid-liquid partition of their thiocyanates, 20: 18828
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V

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(LA-3469)
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WILSON, Daniel W., Deposition of fallout ^{137}Cs at Fort Collins, Colorado, 1962–1964, 20: 18919
WILSON, John N., Temperature monitor for large reactors, 20: 20186 (DP-834)
WILSON, R., Mode of action of bacterial endotoxin as a radioprotective agent in mice exposed to lethal whole-body x irradiation, 20: 18496
WILSON, R., Status of the few-nucleon problem, 20: 19982
WILSON, Richard, Revision of shielding calculations, 20: 19305 (TID-22772)
WILSON, Shirley M., Effect of colcemide on radiosensitivity of mice, 20: 18467
WINCEL, Henryk, Primary processes in radiation chemistry as studied by mass spectrometry. V., 20: 18783
WINCH, D. E., S_n overhead current system approximation, 20: 19689
WINCHESTER, John W., Geochemistry of iodine, bromine, and chlorine in the air-sea-sediment system, 20: 18202 (NYO-3450-1, pp 185-201)
WINDLE, D. W., Power series solution of F2 layer diffusion equation,

20: 19656
WINDORSKI, Frank, Multi-view FOG program and its application to quality control of FSD data, 20: 19044 (UCRL-16508)
WINGATE, M. B., Placental localization by arteriography, 20: 18520
WINKLER, H., Analyzer for measuring transfer function of reactor SAPHIR, 20: 20311 (EIR-87)
WINOCOUR, Ernest, Mechanism of polyoma virus-induced synthesis of cellular DNA, 20: 18369
WINSLOW, G. H., Nonstoichiometry in uranium dioxide, 20: 18666
WINSLOW, G. H., Oxygen self-diffusion in UO_2, 20: 19234
WINTER, Nicholas W., Suggested semiempirical molecular orbital schemes for xenon tetroxide, 20: 18641
WINTLE, C. A., Detecting the onset of burnout in rod clusters, 20: 18859 (AEEW-R-432)
WIT, Romuald, New sum rules for real part of the forward scattering amplitude, 20: 19470
WITALIS, E. A., Characteristics of linear MHD generators with one or a few loads, 20: 19414 (AE-214)
WITTE, Hartmut, Vapor pressure measurements in system lead–thorium, 20: 19244
WIZA, J., Level structure of ^{37}Ar and ^{41}Ar, 20: 19895
WOBIG, H., Plasma losses in toroidal theta pinch with superimposed hexapole, 20: 19999 (IPP-1/44)
WODA, H., Parity mixture in excited nuclear states by measurement of β-γ angular correlation, 20: 19836 (SGAE-PH-36/1965)
WOELFLI, W., Nuclear photoeffect in ^{3}H, 20: 19868
WOJTKOWSKA, J., Gamma rays from inelastic scattering of 14.1-Mev neutrons on ^{12}C and ^{16}O, 20: 19817 (INR-661/IA/PL)
WOLF, Alfred P., Bond energy effects and acetylene production in the reactions of energetic carbon atoms with alkyl halides and propane, 20: 18714
WOLF, G. H., Plasma losses in toroidal theta pinch with superimposed hexapole, 20: 19999 (IPP-1/44)
WOLF, N. S., Cross-field diffusion of quiescent potassium magnetoplasmas, 20: 20016 (NYO-2813-35)
WOLFENSTEIN, L., Analysis of CP violation in possible experiments on K^0 decay, 20: 19474
WOLFF, A., 2-Meter spark chamber magnet model for determination of field distribution in space, 20: 19041 (SLAC-57)
WOLFGANG, Richard, Evidence for formation and reaction of methyne, 20: 18716
WOLFGANG, Richard, Reaction of free carbon atoms with cyclopentadiene, 20: 18715
WOLLNIK, H., Image aberrations for sector fields, 20: 19278
WOLSKI, R., Optical model ambiguities for the α–^{59}Co interaction, 20: 19815 (INP-440/PL)
WONG, E. Y., EPR spectra of Gd^{3+}-doped $LaBr_3$ and $La_2(SO_4)_3 \cdot 9H_2O$, 20: 18668
WONG, Roland, Organoleptic evaluation of irradiated papaya, 20: 18247 (UH-235P5-1, pp 14-25)
WONG, Roland, Shelf-life extension of papayas with gamma irradiation, 20: 18300 (UH-235P5-1, pp 55-74)
WOO, W. K., Effects of sputtering parameters on continuously deposited tantalum nitride films, 20: 19201
WOOD, G. M., Development of a high-temperature molten lithium pump, 20: 18857
WOOD, W. F., Research reactor operational problems, 20: 20323
WOODHAMS, F. W. D., Measurement of narrow-angle scattering of 14.4-kev γ rays by the Moessbauer effect, 20: 19904
WOODS, A. D. B., Thermal vibrations of crystal lattices, 20: 20170
WOODS, S. B., Recombination effects on electron tunneling into superconducting lead, 20: 19744
WOODWARD, R. N., Cadmium-109 in New Zealand rainwater, 20: 18911
WOODWARD, W., Measurements of neutron form factors, 20: 19509
WOTKE, H., Operating experience with Seibersdorf inhomogeneous sector field isotope separator, 20: 19164
WOTKE, H., Thermal ion source for the separation of Cs, 20: 19142
WRAY, L. W., X-ray spectrographic determination of some metal oxide additives in UO_2 and ThO_2, 20: 18558 (AECL-2526)
WRIGHT, E., Balanced quenching method for counting ^{14}C, 20: 18594
WRIGHT, J. R., Advanced reactor systems and their future applications, 20: 20282
WROE, H., Measurements of emittance of output beam of AGS duoplasmatron ion source, 20: 19288 (BNL-10096)
WROE, Harold, Emittance measurements on AGS preinjector with duoplasmatron ion source, 20: 19287 (BNL-10095)
WU, C.-Y., Solvent isotope effect and partial molar volume of ions, 20: 18643
WUENDRICH, K., Influence of gamma radiation on physical properties of gelatin, 20: 18775
WUNDER, H., Check of theoretical predictions for the multipole E_1^{*} in π^0 photoproduction, 20: 19493
WYLER, E. N., Prog. rpt. on radiation reliability of electronics, 1–3/64, 20: 19098 (N-65-17953)
WYSOCKI, J. J., Prog. rpt. on radiation damage in Si, 10/15/63–10/15/64, 20: 19102 (N-65-19693)
WYSOCKI, J. J., Prog. rpt. on radiation damage in Si, 10/15/63–4/15/64, 20: 19106 (N-65-19886)

Y

YADROVSKII, E. L., Singularities in photodisintegration of nuclei with unfilled shells, 20: 19969
YAGI, Kohsuke, Hole state by reactions $^{40}Ca(p,d)^{39}Ca$, $^{52}Cr(p,d)^{51}Cr$, and $^{60}Ni(p,d)^{59}Ni$, 20: 19877
YAHYA, Q. A. M. M., Elementary particles in finite space, 20: 19558
YAKOVLEV, R. M., Elastic scattering of 660-Mev protons on ^{3}He and ^{4}He nuclei, 20: 19978
YAKOVLEV, R. M., Knocking out α particles from carbon nuclei, 20: 1997
YAKUSHEV, E. M., Solution of nonrelativistic equations of motion for a charged particle in a certain class of varying electromagnetic fields, 20: 19282
YAMADA, Osamu, Carbon-14 dating by liquid scintillation counting. I., 20: 18935
YAMAGATA, Hirotada, Mutations induced with radiations in the heading date of rice, 20: 18416
YAMAGUCHI, Hisashi, Intensification for nuclear plate, 20: 19026 (INS-J-94)
YAMAGUCHI, Kikoyuki, Effects of x rays on proliferative capacity of isolated carrot root tissue cells, 20: 18395
YAMAKAWA, K., Correlation of interphase chromosome volume with pollen abortion induced by chronic gamma irradiation, 20: 18384
YAMAMOTO, S., Analysis of ^{134}Cs–^{137}Cs mixtures by gamma-ray spectrometric methods, 20: 18580 (USNRDL-TR-934)
YAMASHITA, Atsushi, Aspects of radiosensitivity of crop plants under chronic exposure, 20: 18420
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 9/62, 20: 19207 (N-65-21346)
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 10/62, 20: 19208 (N-65-21347)
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 12/62, 20: 19209 (N-65-21348)
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 1/63, 20: 19210 (N-65-21349)
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 6/63, 20: 19211 (N-65-21350)
YANG, L., Prog. rpt. on carbides as cathodes for thermionic space reactors, 7/63, 20: 19212 (N-65-21351)
YANG, Mo-Hsiung, Some aspects of preparation of ^{86}Rb, 20: 18811
YANUSHEVSKAYA, M. I., Effect of intestinal tract shielding in irradiated mice on hematopoiesis restoration, 20: 18432
YANUSHEVSKAYA, M. I., Induction of chromosome injuries in mouse bone marrow under the distant effect of ionizing radiation, 20: 18356
YAP, C. T., Beta decay of ^{24}Na, 20: 19898
YAQUB, M., Conference on low-temperature physics, Columbus, Ohio, 9/64. Pt. A., 20: 19774
YAQUB, M., Conference on low-temperature physics, Columbus, Ohio, 9/64. Pt. B., 20: 19775
YARMONENKO, S. P., Antiradiation protection in connection with the problem of the RBE of radiations with low specific ionizations, 20: 18362
YASUKOCHI, Ko, Effect of external current on magnetization of non-ideal type II superconductors, 20: 19735
YATES, J. K., System for driving a metal plate at 1000 m/s, 20: 18879 (AWRE-O-21/66)
YATSUI, Kiyoshi, Harmonic generation in a short magnetized plasma column, 20: 20040
YEARIAN, M. R., Isotope effect in ^{40}Ca, ^{44}Ca, and ^{48}Ca charge distributions from 250-Mev elastic electron scattering, 20: 19936
YEH, Si-Jung, Effects of electron beam irradiation on polyvinyl chloride, 20: 18762
YEH, Si-Jung, Enrichment of ^{51}Cr by Szilard-Chalmers process. II., 20: 18812
YEH, Si-Jung, Some aspects of preparation of ^{86}Rb, 20: 18811
YERANOS, Walter A., Suggested semiempirical molecular orbital schemes for xenon tetroxide, 20: 18641
YEROKHINA, K. I., Coulomb excitation of levels of ^{155}Gd, ^{161}Dy, and ^{171}Yb, 20: 19959
YIN, Pong-cheng, Generalized Regge representation of the scattering amplitude, 20: 19588
YONEI, Katsumi, Solution of Thomas-Fermi-Dirac equation with modified Weizsaecker correction, 20: 19366
YONEZAWA, T., Theory of formation of the ionosphere, 20: 19695
YONTS, O. C., Concepts in developing in-process calutron controls, 20: 19154
YOSHIDA, Kenzo, Radiation-induced liquid-phase oxidation of cumene,

20: 18727 (JAERI-1100)
YOSHIKAWA, Isao, Genetic structure of natural populations of Drosophila melanogaster. IV., 20: 18333
YOSHIMURA, Takauki, Radiation-induced copolymerization of vinyl acetate with sulfur dioxide, 20: 18774
YOUDALE, T., Effects of x irradiation on nuclear structure of rat thymocytes, 20: 18455
YOUDALE, T., Mitotic stimulation in normal and irradiated suspension cultures of rat bone marrow by an elevated salt concentration, 20: 18326
YOUDIN, Myron, Sterilizable Geiger-Mueller tubes for space applications, 20: 19033 (N-65-26400)
YOUNG, Chung-Chang, Spectrophotometric study of cerium(III) and thorium(IV) chelates of DCTA, 20: 18598
YOUNG, Irving, Critical analysis of strontium bone scanning for detection of metastatic cancer, 20: 18513
YOUNG, J. C., Recent developments in integral neutron thermalization, 20: 19779 (GA-6904)
YOUNG, Kiang-Chuen, Radiation of super-phase velocity, 20: 19458
YOUNG, Richard L., Radiation effects on protein and pectin in papaya, 20: 18246 (UH-235P5-1, pp 7-13)
YOUNGHANSE, J. O., Special ORNL isotopic preparations, 20: 19153
YOVANOVICH, M. Michael, Thermal contact conductance in a vacuum, 20: 18867 (NP-15897)
YUDIN, N. P., Electric quadrupole transitions in ^{40}Ca, 20: 19975
YUEH, Man-chuen, Stability of Poiseuille plasma arc in axial magnetic field, 20: 20008 (N-65-22329)
YUFEROV, V. B., Supersonic hydrogen jet in a vacuum, 20: 19639
YUR'EV, B. A., Electric quadrupole transitions in ^{40}Ca, 20: 19975
YUR'EV, V. G., Investigation of volt-ampere characteristics of thermionic converters, 20: 19425
YURIN, V. A., Phase stabilization in γ-irradiated ferroelectric materials, 20: 20172
YURIN, V. A., Piezoelectric effect and internal friction in γ-irradiated Rochelle salt crystals, 20: 20173

Z

ZABAVIN, A. K., Determining the total absorbed dose during internal irradiation, 20: 18955
ZABURUNOVA, I. S., Certain regularities in accumulation of yttrium and strontium by marine organisms, 20: 18215
ZACHARIASEN, F., Bootstraps, 20: 19523
ZAKHAROVA, A. E., Production of stable krypton and xenon isotopes by irradiation of aluminum halides in reactors, 20: 18731
ZAMOTORIN, M. I., Effect of zirconium on mechanical and electrical properties of aluminum, 20: 19241
ZAPLATYNSKY, Isidor, System tantalum–hafnium–carbon at 2050°C, 20: 19213 (N-65-21739)
ZAUSIG, B., Silicon surface-barrier detectors, 20: 19078
ZAVADA, Vojtech, Capacity of bacterial host for reproduction of RNA phage f2. II., 20: 18316
ZAVELSKII, F. S., Radiocarbon dates of Lab. of the Geological Inst., USSR, 20: 18931
ZEDELASHVILI, E. N., Physical and chemical properties of product formed by radiolysis of crystalline o-nitroaniline, 20: 18743
ZELWER, C., Crystal structure of $LaAlO_3$, 20: 19227
ZHABROVA, G. M., Radiation-catalytic conversion of methanol, 20: 18744
ZHELNOVA, V. K., Effects of radioactive strontium on the harvest of agricultural plants in lime soil, 20: 18303
ZHILINSKII, A. P., Electromagnetic radiation from an electron beam traversing a plasma in a magnetic field, 20: 20071
ZHUKOV-VEREZHNIKOV, N. N., Results of microbiological and cytological investigations conducted during the flights of Vostok type vehicles, 20: 18363
ZHUSUPOV, M. A., Threshold states and ordered width of nucleon associations in light nuclei, 20: 19822 (JINR-P-2301)
ZIEGENBEIN, D., Fission gas behavior in the particle structure of a nuclear fuel paste. I., 20: 20222
ZIMBERG, Yale H., Evaluation of lymph node function following irradiation or surgery, 20: 18306
ZIMMERMAN, W. Bruce, Young's modulus of lithium between 10 and 300°K, 20: 19221 (TID-21670)
ZIONI, J., First $r = 1$ level in ^{58}Cu, 20: 19914
ZIVI, S. M., Heat conduction criterion for dispersal of molten reactor fuel by transient boiling of coolant, 20: 20180 (STL-372-27, pp 22-35)
ZIVI, S. M., Hydrodynamic stability of natural circulation boiling systems, 20: 18871 (STL-372-14(1))
ZIVI, S. M., Prog. rpt. on kinetics studies of heterogeneous water reactors, 9/30/65, 20: 20178 (STL-372-27)
ZMUDA, A. J., VIf phase perturbations produced by the Soviet high-altitude nuclear explosion of November 1, 1962, 20: 19677
ZOLOTAVIN, A. V., Auger electrons of ^{160}Er and ^{160}Ho, 20: 19958
ZONDERHUIS, J., Determination of mercury in potato flour, 20: 18595
ZSEBOEK, Z., Protective action of AET in disturbances of Na and H_2O metabolism, 20: 18458
ZUPPINGER, A., Influence of cortisone on radiation effect of bones, 20: 18480
ZWANZIG, Robert, Approximate eigenfunctions of the Liouville operator in classical many-body systems, 20: 19280
ZWICKER, H., Influence of impurities on electron temperature in a theta pinch, 20: 20046
ZYKOV, V. G., Interaction of polarized plasma streams in a magnetic field that increases toward the periphery, 20: 20081
ZYLBERACH, S., Preliminary results on the charged decay modes of K^0_2, 20: 19431 (ANL-7130, pp 77-81)
ZYLBERSTEJN, A., Preliminary results on the charged decay modes of K^0_2, 20: 19431 (ANL-7130, pp 77-81)

SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included in cumulative indexes to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Gland and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings, e.g., Amino Acids rather than Acids, Amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases parenthetic modifying terms or inverted headings of the form Neutrons, Fast are used in preference to a direct entry that would result in the scattering of information. Organic compounds are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of Chemical Abstracts, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are alphabetized word-by-word. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out.

Examples:

M-Capture
  see Electron Capture
Magnesium
Magnesium Alloys
Manganese Fluorides
Manganese(II) Fluorides
Mesons
Mesons (π)
Mesons (ρ)
3-Pentanol, 2,4-Dimethyl-
2-Pentanol, 2-Methyl-
2-Pentanol, 4-Methyl-

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Alloys and Other Systems

Multicomponent alloys, except well-known trade names, are indexed under a main heading in the form "element alloy" for each element in the alloy. The modifier begins with element symbols for each component arranged alphabetically as if the English name for the element were spelled out.

Example: Copper-Gold Alloy is indexed
  Copper Alloys
    Cu-Au...
  Gold Alloys
    Cu-Au...

Well-known alloys such as Zircaloy-2 are indexed directly to the trade name; cross references referring from each component of the alloy to the entry for the trade name appear in cumulative indexes.

Multicomponent systems of non-metallic elements are indexed in a manner similar to alloys except the main heading used contains the word "Systems" in place of "Alloys."

Example: Silicon–Tungsten Systems are indexed
  Silicon Systems
    Si-W...
  Tungsten Systems
    Si-W...

Multicompound systems and mixtures of compounds are indexed under the main heading for each component com-

pound; the modifiers begin with an alphabetical listing of compound formulas.

Example: Lead Titanate–Lead Zirconate is indexed
Lead Titanates
$PbTiO_3$-$PbZrO_3$...
Lead Zirconates
$PbTiO_3$-$PbZrO_3$...

A mixed system of compounds and elements is indexed using a combined form of the above conventions, e.g., a dispersion of copper and alumina would be indexed

Aluminum Oxides
Al_2O_3-Cu...
Copper Systems
Al_2O_3-Cu..

Physical States and Configurations of Materials

Specification of the physical state, if other than normal, or geometric configuration of the material is included in the modifying phrase, i.e., liquid metals would be indexed to the metal with "liquid" in the modifier, and carbon crucibles would be indexed to Carbon with "crucibles" appropriately placed in the modifier and also to Crucibles if appropriate.

Modifying Phrases

The modifiers appearing under a main heading are written specifically to describe the relation of the item being indexed to that main heading. The modifier, therefore, will generally contain more useful information about that relation than will a title or a phrase written to be used under every main heading assigned to the item. Effort is exerted to begin the modifier with the word judged to be of greatest use to the greatest number of users; this, however, does not obviate the need to consider all modifiers under the main heading(s) of interest.

Modifiers are usually intended to form a meaningful phrase when combined with the main heading. Some are intended to be read following the main heading, e.g., the entry Hydrogen—sorption by charcoal is read "hydrogen sorption by charcoal"; however, as a result of placing the important word first, many modifiers must be arranged for smooth reading, e.g., Formaldehyde—yields in radiolysis of ethyl ether, effects of deuterium on is read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and Uranium—crystal structure of, effect of cooling rate on allotropic transformations in is read "effect of cooling rate on allotropic transformations in crystal structure of uranium." Prepositions are sometimes omitted if no ambiguity results.

Special characters are added to modifiers in the field of physics; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the journal reference number. The value of this identification has been established by the American Institute of Physics.

A

ABSTRACTS
on accelerator and space shielding, 20: 20098 (ORNL-RSIC-12(Vol.1))
on production and industrial uses of radiation and radioisotopes, 20: 19117 (ORNL-TM-1356(Suppl.1))
ACCELERATION
effects of, combined with proton-irradiation on shielded rats, 20: 18441
radiosensitivity effects on mice during simulated space flight, gamma, 20: 18443
ACCELERATOR TUBES
design with inclined electrodes for Van de Graaff accelerators, 20: 19315
ACCELERATORS
beam current restrictions from limiting particle density in phase volume, (T), 20: 19302 (NP-15796)
beam injection system for proton, design of, 20: 19299 (MURA-707)
beam monitoring system for, design of, 20: 19292 (CERN-66-5)
beam motion during injection in, space charge effects on, 20: 19316
beam orbit stability in eccentric magnetic fields, (T), 20: 19306 (ZfK-PhA-2)
beam pulses from, effects on coincidence measurements, 20: 19310
beam source for, design of pulsed, 20: 19322(P)
beam transport magnets using iron yokes, (T), 20: 19293 (CERN-66-7)
design concepts for ultra-high-energy, 20: 19273(R) (BNL-929, pp 3-43)
design for electrons or ions, 20: 19320(P)
design of advanced high-energy, 20: 19285(R) (BNL-929, pp 44-57)
development of low- and medium-energy, review of, 20: 19313
ion sources for, design and performance of sputtering, 20: 19309
shielding of, bibliography on, 20: 20098 (ORNL-RSIC-12(Vol.1))
storage rings for, beam accumulation by r-f stacking in, (T), 20: 19294 (CERN-66-9)
storage rings for, vacuum pump for Adone, 20: 18889 (LNF-65/38)
targets for production of neutrons, conference on, 20: 19296 (EUR-2641.d,f,e)
use for neutrino experiments, review, 20: 19439 (ANL-7130, pp 273-84)
voltage stabilizer for, design of, 20: 19323(P)
ACCIDENTS
insurance for nuclear, conference on, 20: 18939 (EUR-2642.f)
iodine-131 release in nuclear, milk contamination by, 20: 18983
ACETAMIDE, IODO-
properties and structure of, 20: 18446
radiosensitivity effects on animal cells, 20: 18444
radiosensitivity effects on bacteria, 20: 18446
ACETIC ACID, [(CARBOXYMETHYLIMINO)BIS(ETHYLENENITRILO)]TETRA-
chelates of, use for cobalt-60 and zinc-65 elimination in rats, 20: 18216
complexes with zinc, radionuclide removal from body using, 20: 18438
effects on excretion of radioactive substances from man, review of, 20: 18438
use as chelating agent in radionuclide removal from body, 20: 18438
use as complexing agent in electrophoretic separations of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
ACETIC ACID, (1,2-CYCLOHEXYLENEDINITRILO)TETRA- COMPLEXES
with cerium, uses in determination of thorium, 20: 18598
ACETIC ACID, [(1,2-DIPHENYLETHYLENE)DINITRILO]TETRA-
synthesis of, for promoting strontium excretion in urine, 20: 18209 (TID-22717)
ACETIC ACID, [ETHYLENEBIS[(CARBOXYMETHYLIMINO)ETHYLENENITRILO]]TETRA-
use as chelating agent in radionuclide removal from body, 20: 18438
ACETIC ACID, (ETHYLENEDIAMINE)TETRA-
use as chelating agent in radionuclide removal from body, 20: 18438
use as complexing agent in electrophoretic separations of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
ACETIC ACID, (ETHYLENEDIAMINE)TETRA- COMPLEXES
with neodymium, thermal properties of, 20: 18679
with terbium, radioinduced fluorescence in, in light and heavy water, uv, 20: 18683
ACETIC ACID, (*N*-HYDROXYETHYLETHYLENEDIAMINE)TRI-
use as complexing agent in electrophoretic separations of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
ACETIC ACID, IODO-
radiosensitivity effects of, and related compounds, on erythrocytes *in vitro*, 20: 18468
ACETIC ACID, MERCAPTO-COMPLEXES
effects on nitrogen mustard toxicity in mice and monkeys, 20: 18474
preparation of, 20: 18474
radiosensitivity effects in mice, 20: 18474
ACETIC ACID, MERCAPTO-, SODIUM SALTS
radiosensitivity effects on yeast, 20: 18503 (AD-611869, pp 169-83)
ACETIC ACID, SELENOBIS(ETHYLENENITRILO)TETRA-
complexes with alkaline earths, stability of, 20: 18209 (TID-22717)
synthesis of, for promoting strontium excretion in urine, 20: 18209 (TID-22717)
ACETIC ACID, VINYL ESTER
radioinduced polymerization with sulfur dioxide, 20: 18774
ACETONE
determination in aqueous solutions by gas chromatography, 20: 18572 (PG-Report-690)
radiolysis of, effects of water on yields from gamma, 20: 18737
ACETONE, THENOYLTRIFLUORO-
solvent properties for americium, 20: 20177(R) (BNL-929, pp 83-105)
solvent properties for americium, synergism with trioctylamine, 20: 20365
uranyl complexes of, preparation and properties of single-crystal, 20: 18682
ACETYLENE
reactions of carbon-14-labeled, to prepare benzene, equipment and catalyst for, 20: 18933
yields from reactions of recoil carbon-11 with alkyl halides or propane, tracer studies of, 20: 18714
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
ACETYLENE, DIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
ACID CARBONATES
analysis for uranium, polarographic, 20: 18612
ACOUSTIC WAVES
propagation in helium and neon afterglow plasmas, Tonks-Dattner resonance determination of radial standing, (E), 20: 20044
use for steam–water void fraction measurements, 20: 20187 (EURAEC-1361)
ACRYLAMIDE POLYMERS
radiation effects on, electron, 20: 18779
ACRYLONITRILES
acrylonitrile–butadiene, radioinduced graft polymerization onto cellulose, 20: 18796(P)
acrylonitrile–styrene, radioinduced graft polymerization onto cellulose, 20: 18799(P)
ACTINIUM ISOTOPES Ac-227
alpha spectra of, francium-223 levels from, (E), 20: 19864
ACTINOMYCIN
radiosensitivity effects on tumor and embryo cells in culture, 20: 18461
radiosensitivity effects on tumors, 20: 18464
radiosensitivity effects on lung carcinomas, 20: 18539
radiosensitivity effects on lung cancers, 20: 18541
ACTIVATION ANALYSIS
equipment for, 20: 18621(P)
equipment for, design and performance of, 20: 18616
methods for determining fluorine in presence of oxygen, 20: 18568(R) (NBL-230)
methods for impurities in boron, 20: 18568(R) (NBL-230)
use in gold-198 dosimetry in guinea pig organs, 20: 18975
uses in studies of archaeological objects, 20: 18556(R) (BNL-929, pp 66-82)
ACTIVATION DETECTORS
development of spiral-wound copper wire, for intracell neutron flux measurements, 20: 20204 (INR-656/IX-A/R)
performance of argon gas, for neutron flux monitoring, 20: 20206 (NAA-SR-11356)
performance of gold foil, 20: 19878
ADENOSINEPHOSPHORIC ACIDS
effects on beating of cultured heart cells, 20: 18210(R) (UCLA-12-576, pp 15-25)
radiosensitivity effects on albumin macromolecules, y, 20: 18259
radiosensitivity effects in mice, 20: 18473
ADENYL PYROPHOSPHATASE
resistance to heat and hydrostatic pressure, effects of heavy water on, 20: 18218(T)
ADRENAL GLANDS
radiation effects on concentration of oxidized and reduced TPN in rat, x, 20: 18343
radiation effects on rat, 20: 18402
ADRENAL HORMONES
radiosensitivity effects on mice, x, 20: 18437
ADRENALINE
effects on blood circulation in cats, 20: 18296(R) (UCLA-12-576, pp 57-60)
effects on blood pressure of rats, effects of AET and cysteamine on, 20: 18239
effects on phosphorus-32 and sulfur-35 uptake by bone, 20: 18479
ADRENOCORTICOTROPIC HORMONE
radiation effects on, x, 20: 18479

radioinduced free radicals in, 20: 18479
AEROSOLS
atmospheric transport of, research on macroscale, mesocale, and microscale, 20: 18198
geochemistry of bromine, chlorine, and iodine in, over Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
monitoring for plutonium, detector for, 20: 19057
AGE
effects on cesium-137 content in man, 20: 18233
effects on frequency of x-ray exposure during pregnancy, 20: 18506
effects on urethan-induced leukemogenesis in mice treated by thymectomy and subsequent thymus implantation, 20: 18192
radiosensitivity effects on yield of temperature-sensitive mutations in Paramecium, x, 20: 18349
radiosensitivity effects on mutation frequency in tomato pollen, γ, 20: 18393
radiosensitivity effects on rat kidneys, 20: 18284 (AD-629512)
AGE ESTIMATION
argon–potassium method of, for micas, 20: 18929
carbon-14 method of, in USSR, 20: 18931
carbon-14 method of, preparation of diborane and silica–alumina catalyst for acetylene to benzene conversion in, 20: 18933
carbon-14 method of, for bones, shells, tools, and weapons in Pacific Islands, 20: 18937
carbon-14 method of, catalyst for benzene synthesis for scintillation spectrometry in, 20: 18710
errors in lead-isotope, 20: 18928
uranium–lead method of, for zircons, 20: 18929
AGING
radiation effects on mouse, 20: 18198
AGRICULTURE
nuclear energy in, review, 20: 20367
poultry research in, review of tracer studies on, 20: 18236
radiation effects for plant selection in, 20: 18409
research in agronomy, using reactors, 20: 20342
research in, using reactors, 20: 20341
stable isotope uses in, 20: 19120
AIR
alpha range-energy relation in, use of solid-state detector for measurement of, 20: 19069
electron beam interactions with, plasma production during instability in, (E), 20: 20078
flow of ionized, in nonconducting channel, electric-field effects on turbulent, (T), 20: 19637
heat transfer by turbulent flow of, in parallel rod arrays, 20: 18876
radiation effects on ozone formation in, gamma, 20: 18746
thermal conductivity of liquid, 20: 19614 (N-65-17283)
air–heptane, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)
air–H_2O, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)
AIR FORCE ENGINEERING TEST REACTOR
control and instrumentation systems for, 20: 20306 (ACNP-62599(Vol.1))
design, 20: 20306 (ACNP-62599(Vol.1))
experimental facilities for, design of, 20: 20306 (ACNP-62599(Vol.1))
hazards analysis for, 20: 20306 (ACNP-62599(Vol.1))
shielding for, biological and thermal, 20: 20306 (ACNP-62599(Vol.1))
waste disposal system for, 20: 20306 (ACNP-62599(Vol.1))
AIR FORCE NUCLEAR ENGINEERING TEST FACILITY
description of, environmental and mechanical, 20: 20306 (ACNP-62599(Vol.1))
AIRCRAFT
radiative contamination of commercial, control measures for, 20: 18959
ALANINE, 3-(3,4-DIHYDROXYPHENYL)-
radiosensitivity effects on pigments in mouse hair, x, 20: 18502
ALANINE, 2-METHYL-
radiation effects on crystals of, ESR spectral studies on free radicals produced by, 20: 18750
ALANINE, PHENYL-
labeling with tritium following radiolysis of ribonuclease, 20: 18749
radiosensitivity effects on pigments in mouse hair, x, 20: 18502
ALARM SYSTEMS
design of gamma monitor, for Rossendorf research reactor, 20: 20316 (ZfK-RN-29)
ALASKA
radioactivity in foods and people in, 1963 to 1965, 20: 18980
ALBUMINS
radiation chemistry of bovine serum, uv and x, 20: 18791
radiation effects on blood, 20: 18198
radiation effects on frog serum content, gamma, 20: 18243 (NIJS-R-454)
radiation effects on, protective effects of ATP against γ, 20: 18259
ALGAE
photosynthetic activity in, tracer study, 20: 18206 (N-65-16815)
strontium-90 uptake by marine, correlation with buildup factor, 20: 18215
yttrium-91 uptake by Ulva, correlation with buildup factor, 20: 18215
ALKALI METAL HYDRIDES
spectra of, isotope effects on vibrational transition probabilities in, 20: 18639
ALKALINE EARTH COMPLEXES
with selenobis (ethylenenitrilo) tetraacetic acid, stability of, 20: 18209 (TID-22717)
ALKALOIDS
labeling pegene-9-desoxyvasicine with carbon-14, 20: 18723
ALKANES
carbon-11 recoil reactions with, labeled compound yields in, 20: 18556(R) (BNL-929, pp 66-82)
ALLOYS
book: *Superconductivity of Metals and Alloys*, 20: 19773(T)
fracture initiation and modes of failure of dispersion-hardened, 20: 19218 (NYO-2394-18)
magnetic transitions in dilute, Mössbauer studies of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
preparation and properties of metastable, 20: 20365
properties at high temperature, bibliography on, 20: 19216 (NP-15388)
ALPHA PARTICLES
angular and energy distributions from neutron reactions (n,α) with argon-40 at 14.1 Mev, 20: 19853
angular distributions from oxygen-16 (d,α) and (p,α) reactions, (T), 20: 19967
angular distributions from silicon-30 (d,α) reactions at 6.5 and 6.7 Mev, (E), 20: 19971
angular distributions from carbon-12 and -13 (d,α) reactions at 6.2 to 6.9 Mev, (E), 20: 19972
angular distributions from uranium (n,f) reactions at 14 Mev, (E), 20: 19861
dosimetry in bones, review of experimental and theoretical methods for, 20: 18954
dosimetry using energy distribution in contact medium, 20: 18960
effects on iodomethane in cyclohexene, tracer studies of, 20: 18771
effects on luminescence of manganese-doped cadmium zinc sulfides in presence of infrared radiation, 20: 18738
effects on molecular gases, dose partition in, 20: 18754
effects on silicon single crystals, (E/T), 20: 19273(E) (BNL-929, pp 3-43)
emission from radon-222 in monocrystalline tungsten, 20: 20129
emission in carbon-12 (p,pα) reactions at 660 Mev, cross sections for, (E), 20: 19977
range-energy relation in air, measurement using solid-state detectors, 20: 19069
reactions (α,d) and (α,t) with aluminum-27, beryllium-9, and fluorine-19 at 28.6 Mev, momentum spectra from, (E), 20: 19876
reactions (α,γ) with lithium-6, level transition strengths from, (E), 20: 19911
reactions (α,n) with oxygen-18 at 2.8 Mev, level triplet from, (E), 20: 19909
reactions (α,p) with fluorine-19 at 1.3 to 2.6 Mev, energies and strengths of resonances in, (E), 20: 19938
reactions (α,t) with boron-11, angular distributions from, (T), 20: 19967
reactions with carbon-13 and fluorine-19, mechanism of direct, (T), 20: 19947
reactions with cobalt-59, optical-model potential for, (E/T), 20: 19815 (INP-440/PL)
reactions with oxygen-16 in water at 30 Mev, production of fluorine-18 by, 20: 18809
scattering by nuclei at 25 Mev, angular distributions from inelastic, (T), 20: 19816 (INP-441/PL)
scattering by nuclei, level deformation lengths from inelastic, (E), 20: 19910
ALPHA SOURCES
calibration of, methods for, 20: 18562(R) (EUR-2640.e)
determination in expired breath, design of electrometer for, 20: 18235
isotopic compositions of, design of alpha spectrometer for determining, 20: 18562(R) (EUR-2640.e)
measurement simultaneously with beta sources, proportional detector pair for, 20: 19058
ALPHA SPECTROMETERS
design of, using semiconductor detector, 20: 18562(R) (EUR-2640.e)
uses for determining plutonium and uranium in solutions, 20: 18568(R) (NBL-230)
ALTITUDE
radiosensitivity effects on photosynthesis, uv, 20: 18365
ALUMINUM
analysis for boron, methods of, in mixtures, 20: 18568(R) (NBL-230)
argon-ion reactions at 50 kev, energy loss in large-angle, (E), 20: 19369
coating with uranium oxide by electrolysis, effects of electrolyte on, 20: 18691

determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
deuteron-reactions at 20 kev, penetration-depth distributions from, (E), 20: 20137
dislocation structures and internal friction of, correlation of, 20: 20111 (NYO-2471-12)
effects on thorium dioxide–uranium dioxide fuel particle solubility in fluoride–nitric acid solutions, 20: 18819 (AAEC/E-143)
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
electron tunneling in superconducting lead junctions with, structure from recombination effects on, (E), 20: 19744
fabrication of cylinders of, using magnetic fields, 20: 19199 (RT/EL-(65)9)
heat transfer in porous air-cooled foil matrices of, using radiant heat source, 20: 18875
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron elastic and inelastic scattering by, fast, 20: 19805(R) (ANL-7110, pp 1-28)
neutron elastic scattering at 84 to 350 Mev, differential cross sections from second-order multiple scattering theory, 20: 19933
neutron total cross section of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron total cross section at 4 to 12 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
performance of secondary emission monitors of, energy dependence of, 20: 19024 (DESY-65/16)
properties of, effects of purity on electric and superconducting, 20: 19737
properties of, effects of zirconium on electrical and mechanical, 20: 19241
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
proton elastic scattering by, potentials from second-order multiple scattering theory, 20: 19933
proton elastic scattering at 156 to 300 Mev, differential cross sections and polarization from second-order multiple scattering theory, 20: 19933
proton reactions (p,γ) with monocrystalline, orientation dependence of yields from, (E), 20: 20130
proton scattering by monocrystalline, orientation dependence of yield of Rutherford, (E/T), 20: 20131
radiation effects on crystal structure of, at −196°C, neutron, 20: 19260
reactions with β-hydroxyethyl-2,4-dinitrophenyl disulfide, 20: 18722
reactions with lithium hydride, thermodynamics of, 20: 20177(R) (BNL-929, pp 83-105)
reactions with uranium alloys and oxides at 600°C, 20: 19178(R) (IDO-17154)
reactions with uranium nitride at 400 to 600°C, 20: 19187 (BMI-1760)
separation from rare earths by ion exchange chromatography, 20: 18827
sputtering by argon ions at 20 kev, transparency model for, (E), 20: 19371
welding of, to Zircaloy-4, process development for explosive, 20: 19177(R) (BMI-1757)

ALUMINUM ALLOYS
corrosion of 7075-T6 and 7075-T73 by sodium chloride, kryptonate method for studying, 20: 18570(R) (NYO-2757-5)
properties for fuel cladding, 20: 20365
radiation effects on crystal structure of, at −196°C, neutron, 20: 19260
Al–Al_4U, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–Be, corrosion by water at 163°C, effects of beryllium content on, 20: 19178(R) (IDO-17154)
Al–Ce, phase diagram and crystal structure of intermetallic compounds in, 20: 19247
Al–Li, radioinduced tritium for bubbles in, behavior of neutron, (E), 20: 19265
Al–Pr, phase diagram and crystal structure of intermetallic compounds in, 20: 19247
Al–Sn–U, fission product distribution in, 20: 19178(R) (IDO-17154)
Al–Sn–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
Al–U, analysis for uranium by gamma absorption, 20: 18603
Al–U, analysis for uranium, comparison of methods for, 20: 18604
Al–U, production of intermetallic compounds of, for use as reactor fuels, 20: 19178(R) (IDO-17154)
Al–U, reactions of UAl_3 in, with aluminum at 600°C, 20: 19178(R) (IDO-17154)
Al–Zn, radiation effects on crystal structure of, at −196°C, neutron, 20: 19260
Al–Zr, properties of, electric and mechanical, 20: 19241

ALUMINUM BROMIDES
radiation chemistry of, krypton isotope production from, 20: 18731

ALUMINUM CHLORIDES
positron annihilation in, origin of second lifetime component from, (E), 20: 19486

ALUMINUM IODIDES
radiation chemistry of, xenon isotope production from, 20: 18731

ALUMINUM ISOTOPES Al-26
beta transition in isomeric, ft value for, (E), 20: 19951

ALUMINUM ISOTOPES Al-27
alpha reactions (α,d) and (α,t) at 28.6 Mev, momentum spectra from, (E), 20: 19876
deuteron reactions (d,n) at 7.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron reactions (n,α) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
proton reactions (p,αγ), (p,γ), and (p,p′γ) at 4.0 to 6.7 Mev, cross section fluctuations for, (E), 20: 19814 (IKF-15)

ALUMINUM ISOTOPES Al-28
energy levels from silicon-30 (d,α) reactions, spins of, (E), 20: 19971

ALUMINUM NITRATES
analytical use for ion exchange separation of americium, curium, and and rare earths, 20: 18562(R) (EUR-2640.e)

ALUMINUM OXIDES
effects on gamma radiolysis of methanol, catalytic, 20: 18744
performance as gaseous core reactor tube, 20: 20301 (NP-15906)
preparation of thin films of, 20: 19097 (N-65-17886)
radiation effects on carbon dioxide sorption by, at 20 to 350°C, 20: 19264
radiation effects on, EPR studies of ion pair formation in, 20: 18740
sorptive properties for cesium, 20: 19422 (N-65-26628)
Al_2O_3–SiO_2, effects of irradiated, on reactions of isopropylbenzene, 20: 18768
Al_2O_3–SiO_2, uses as catalyst in conversion of acetylene to benzene, 20: 18933
Al_2O_3–W, development of oxidation-resistant, 20: 19193

ALUMINUM SILICATES
effects on gamma radiolysis of methanol, catalytic, 20: 18744

ALUMINUM SYSTEMS
Al–B_4C–U_3O_8, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–BeO–UO_2, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–Mg–Si, fabrication of cylinders of Anticorodal, using magnetic fields, 20: 19199 (RT/EL-(65)9)
Al–Si–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
Al–UN, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–UO_2, fission product distribution in dispersion fuels of, 20: 19178(R) (IDO-17154)
Al–U_3O_8, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)

AMERICIUM
determination of, gravimetric micro-, 20: 18581
preparation of thick and thin sources of, by electroplating and electrophoresis, 20: 18562(R) (EUR-2640.e)
separation from aqueous solutions by solvent extraction using TTA, 20: 20177(R) (BNL-929, pp 83-105)
separation from curium by ion exchange, 20: 18848
separation from curium and rare earths by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from curium and rare earths by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)

AMERICIUM IONS
solvent distribution in nitric acid solutions with dodecylamine and trioctylphosphine oxide in diethylbenzene, effects of lithium nitrate on, 20: 18561 (EUR-2635.d)

AMERICIUM ISOTOPES Am-241
calibration of, for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
calibration of, methods for, 20: 18562(R) (EUR-2640.e)
half life, (E), 20: 19805(R) (ANL-7110, pp 1-28)
use as radiation source in x-ray fluorescence analysis of ores, 20: 18593

AMERICIUM ISOTOPES Am-242
separation and processing at ORNL calutron, 20: 19165

AMIDE POLYMERS
radiation effects on properties of fibers of, gamma, 20: 18747

AMIDES

electron spin resonance spectra of, 20: 20177(R) (BNL-929, pp 83-105)
AMINES
complexes with cerium, thorium, and uranium nitrates, thermodynamic properties of, 20: 18829
radiation effects on resonance charge transfer in aromatic, in solid solutions with carbon tetrachloride, 20: 18751
radioinduced release of, from animal cells, 20: 18454
radiosensitivity effects in mice, 20: 18454
release from tissues, effects of anoxia on, 20: 18454
solvent properties of tertiary, for thorium, 20: 18829
solvent properties for uranium mobile installation, 20: 18836
AMINO ACIDS
analysis of nanomolar amounts of, automated procedure for, 20: 18205(R) (LA-3432, pp 178-262)
content in rabbit antibodies, 20: 18184(R) (BNL-929, pp 115-25)
incorporation in RNA of carbon-14-labeled, biological effects of, 20: 18249
radiation effects on, in wool, tracer studies of uv, 20: 18281
spectra from, computer analysis of ultraviolet, 20: 18205(R) (LA-3432, pp 178-262)
AMMETERS
design of fast response, for $\mu\mu$ amp currents, 20: 18989 (EGG-1183-1165)
AMMINES
complexes with cobalt, Szilard-Chalmers reactions of, on ion exchanger, 20: 18764
AMMONIA
effects on polarographic reduction of benzophenone in ethanol–water system, 20: 18636(R) (TID-22725)
properties of, review on chemical and physical, 20: 18622 (CEA-Bib-57)
radiation effects on synthesis of, gamma, 20: 20177(R) (BNL-929, pp 83-105)
reactions with europium and ytterbium at −75.9°C, 20: 18689
reactions with uranium tetrachloride in ionic melts, precipitation of uranium nitrides by, 20: 18698
AMMONIUM COMPOUNDS, QUATERNARY
tridecylmethylammonium nitrate, solvent properties for uranium, 20: 18839
AMMONIUM FLUORIDES
effects on electrolytic deposition of uranium oxides on metals, 20: 18691
AMMONIUM FLUOSILICATES
structure of cubic, neutron diffraction and inelastic scattering studies on, 20: 18661
AMMONIUM IONS
exchange with barium on zeolite, thermodynamics of, 20: 18629(R) (NP-15353)
AMMONIUM NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
AMMONIUM SULFATES
radioinduced paramagnetic defects in normal and deuterated, thermal annealing of, 20: 18761
AMPLIFIERS
design and performance of solid-state low-noise pre-, 20: 19005
design for $\mu\mu$ amp current measurements, 20: 18989 (EGG-1183-1165)
transfer characteristics of logarithmic, 20: 19006
ANALYSIS
methods of, using atomic absorption, 20: 18591
ANEMIA
pathology of hookworm-induced, in man, 20: 18190 (UCRL-16613)
ANESTHETICS
use of phencyclidine hydrochloride as, for monkeys, 20: 18289(R) (LA-3432, pp 56-101)
ANILINE, 2-NITRO-
radiolysis of crystalline, chemical and physical properties of product of gamma, 20: 18743
ANILINE, 4-NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)
ANIMAL CELLS
division and growth in cultures, studies of synchronous, 20: 18185(R) (BNL-929, pp 126-47)
effects of disulfides and thiols in liver cells in culture, biochemical, 20: 18453
fatty acid metabolism by cultured, 20: 18210(R) (UCLA-12-576, pp 15-25)
growth of cultured beating-heart, effects of enzymes on, 20: 18210(R) (UCLA-12-576, pp 15-25)
growth of cultured lymphoma, effects of nitrogen mustard on, 20: 18462
membranes of, material transport across, 20: 18184(R) (BNL-929, pp 115-25)
metabolism in mammalian, in tissue culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
metallic element content in, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
photosensitivity of, effects of furocoumarins on, 20: 18469
physiology of, effects of radioprotective and radiosensitizing compounds on, 20: 18444
radiation effects on formation of giant erythropoietic, mechanism for x, 20: 18325
radiation effects on mitosis in rat bone marrow, protective effects of sodium against x, 20: 18326
radiation effects on cervical carcinoma, gamma, 20: 18330
radiation effects on vaginal, following cervical carcinoma therapy, 20: 18331
radiation effects on Ehrlich ascites tumor, oxygen enhancement ratio for aberrant x, 20: 18352
radiation effects on embryonic mouse and rat, effects on DNA induction by Polyoma virus of, x, 20: 18369
radiation effects on, protective effects of 5-methoxytryptamine against x, 20: 18430
radiation effects on aging of, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on mast-type, 20: 18198
radiation effects on DNA synthesis in intestine and liver, 20: 18278
radioinduced release of amines from, 20: 18454
radiosensitivity of cultures of, effects of 5-bromodeoxyuridine on uv, 20: 18373
radiosensitivity of, effects of bromouracil, cysteamine and iodoacetamide on, 20: 18444
radiosensitivity of, effects of organophosphorus compounds on, 20: 18482
resistance to heat and hydrostatic pressure, effects of heavy water on, 20: 18218(T)
separation of, electrophoretic, 20: 18297(R) (UCLA-12-576, pp 81-8)
ANIMAL METABOLISM
effects of temperature on, in mice, 20: 18203(R) (LA-3432, pp 21-55)
in mammalian cells in tissue culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
ANIMAL REPRODUCTION
radiation effects on female mouse, x, 20: 18403
ANIMAL RESPIRATION
in mammalian cells in tissue culture, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
radiation effects on, in Bombyx eggs, x, 20: 18301
ANIMALS
effects of radioprotective compounds on, techniques for evaluation of, 20: 18471
iodine-131 content in thyroid gland of herbivorous and granivorous, living on contaminated terrain, 20: 18211(R) (UCLA-12-576, pp 88-111)
radiation effects on genetic processes of, 20: 18198
radionuclide content in marine, in northeast Pacific Ocean, 20: 18903 (RLO-1750-3)
ANISOLE
decomposition by heat, mechanism and products of, 20: 19135(R) (K-C-718)
separation of water from, methods for, 20: 19135(R) (K-C-718)
anisole–BF_3, corrosive effects on metals and polymers, 20: 19135(R) (K-C-718)
anisole–BF_3, physical properties, 20: 19135(R) (K-C-718)
ANISOLE COMPLEXES
with boron trifluoride and hydrogen fluoride in nickel corrosion tests, spectral studies on, 20: 19135(R) (K-C-718)
ANISOLE, METHYL-
production in decomposition of anisole by heat, 20: 19135(R) (K-C-718)
ANISOLE, NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)
ANOXIA
effects on release of amines from tissues, 20: 18454
radiation effects on rat resistance to, x, 20: 18272
radiosensitivity effects in mice, x, 20: 18431
radiosensitivity effects in tissues, 20: 18548
ANTARCTICA
tritium content in snow mine in, 20: 18909
ANTENNAS
radiation emission patterns in compressible plasma, reciprocity relations for, (T), 20: 20037
use in extragalactic radio source position determination, (T), 20: 19348
ANTHRACENE
electric conductivity of ionized, temperature effects on equivalent, 20: 20177(R) (BNL-929, pp 83-105)
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
x-ray scattering by, Raman lines in, (E), 20: 18559 (CALT-221-14)
ANTIBODIES
amino acid content in rabbit, 20: 18184(R) (BNL-929, pp 115-25)

radiation effects on responses of mouse, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on mouse sensitivity to antigen complexes with, 20: 18282
ANTIGENS
radiation effects on mouse sensitivity to antibody complexes with, 20: 18282
ANTIMONY
determination in antimony–tin alloys using beta back scattering, 20: 18587
distribution in sea water, effects of depth on, 20: 18892 (NYO-3450-1, pp 41-89)
separation from other fission products, rapid, 20: 18838
ANTIMONY ALLOYS
Sb–Sn, analysis for antimony, lead, and tin using beta back scattering, 20: 18587
Sb–Sn, magnetic hysteresis loops in superconducting, (E), 20: 19741
Sb–Sn, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745
ANTIMONY ISOTOPES
gamma spectra and delayed neutron emission from, 20: 18838
separation in Karlsruhe mass spectrometer, contamination and resolution in, 20: 19147
ANTIMONY ISOTOPES Sb-122
beta decay of, gamma spectra from, (E), 20: 19960
ANTIMONY ISOTOPES Sb-124
half life of, calorimetric determination of, 20: 19871
ANTIMONY ISOTOPES Sb-125
content in water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
energy levels from tin-125 decay, (E), 20: 19900
ANTINEUTRINOS
interactions with protons, meson (π) production cross sections for, (E), 20: 19438 (ANL-7130, pp 257-71)
interactions with electrons and positrons, two- and four-component theories in, 20: 19463
interactions with electrons, polarization in, (T), 20: 19464
ANTIPARTICLES
theory for, CP invariance in mirror particle, 20: 19587
ANTIPROTONS
annihilation in deuterium, model of, 20: 19273(R) (BNL-929, pp 3-43)
interactions with nucleons in nuclear emulsions at 725 Mev/c, particle distributions from, (E), 20: 19465
interactions with protons at 3.0 to 4.0 Bev/c, cross sections for charge-exchange, (E), 20: 19497
interactions with protons at 5.7 Bev/c, four-pion production in annihilation, (E), 20: 19498
ANTIPYRINE, 4-IODO-
iodine-131 exchange between, and elementary iodine, effects of nitro compounds on, 20: 18690
ARABINOSE
transport in hamster intestine, effects of heavy water and water on active and passive, 20: 18212
ARACHNIDS
radiosensitivity of mite, x, 20: 18302
ARAGONITES
precipitation with strontium ions from aqueous solutions, 20: 18631 (NYO-2266-1)
strontium content in marine, estimation of strontium content in sea water from, 20: 18631 (NYO-2266-1)
ARGON
current harmonic production in weakly ionized plasma of, in electric field, (T), 20: 20031
density variations in turbulent weakly ionized plasma of, (E/T), 20: 20049
effects on absorption spectra of cesium, pressure, (E), 20: 19385
effects on radiolysis of deuterated hydrocarbons in presence of hydrogen, proton-transfer, 20: 18742
electric conductivity of cesium-seeded plasma of, in MHD cells, (E/T), 20: 19417(R) (N-65-21774)
electron beam interactions with, plasma production during instability in, (E), 20: 20078
electron densities in shock-produced plasma of, microwave-reflection measurement of high, (E), 20: 20022
electron distribution in, solution of Thomas-Fermi-Dirac equation for, 20: 19366
ion elastic scattering at 10 to 600 ev, cross sections for argon and helium, (E), 20: 19392
neutron scattering by liquid, review on, (E), 20: 19799
oscillations in magnetized plasma column of, harmonic generation from helical, (E), 20: 20040
properties of h-f discharge plasma of, magnetic-field effects on, (E), 20: 20087
thermal conductivity of liquid, 20: 19614 (N-65-17283)
ARGON IONS
production by high-temperature hollow cathode ion source, 20: 19002
reactions with aluminum of 50 kev, energy loss in large-angle, (E), 20: 19369
reactions with tungsten at 200 ev to 4 kev, diffusion of trapped gas following, 20: 20128
scattering by argon at 10 to 600 ev, cross sections for elastic, (E), 20: 19392
sputtering on aluminum, copper, gold, and lead at 20 kev, transparency model for, (E), 20: 19371
sputtering on copper crystals, yields from, (T), 20: 19407
sputtering reactions on oriented gold foils at 50 kev, (E), 20: 19372
ARGON ISOTOPES Ar-33
half life, (E), 20: 20365
production and delayed proton emission by, 20: 18556(R) (BNL-929, pp 66-82)
ARGON ISOTOPES Ar-36
deuteron reactions (d,p) at 11 Mev, argon-37 level structure from, (E), 20: 19895
energy levels from proton reactions (p,α) with potassium-39 at 10 to 13 Mev, (E), 20: 19902
ARGON ISOTOPES Ar-37
energy level structure from deuteron reactions (d,p) with argon-36 at 11 Mev, (E), 20: 19895
energy levels from chlorine-37 (p,n) reactions, spin of 1.42-Mev, (E), 20: 19891
half life, 20: 18556(R) (BNL-929, pp 66-82)
measurement in meteorites, determination of cosmic radiation variations from, 20: 18556(R) (BNL-929, pp 66-82)
ARGON ISOTOPES Ar-39
half life, 20: 18556(R) (BNL-929, pp 66-82)
measurement in meteorites, determination of cosmic radiation variations from, 20: 18556(R) (BNL-929, pp 66-82)
ARGON ISOTOPES Ar-40
content in rocks in United States, age estimations from, 20: 18924(R) (NYO-1669-11)
content in sediments in New Jersey Triassic Basin, age estimation from, 20: 18924(R) (NYO-1669-11)
deuteron reactions (d,p) at 11 Mev, argon-41 level structure from, (E), 20: 19895
neutron reactions (n,α) at 14.1 Mev, alpha angular and energy distributions from, (E), 20: 19853
proton elastic scattering by isobaric analog resonance fine structure from, (E), 20: 19905
use for neutron flux monitoring in reactors, 20: 20206 (NAA-SR-11356)
ARGON ISOTOPES Ar-41
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
energy level structure from deuteron reactions (d,p) with argon-40 at 11 Mev, (E), 20: 19895
ARGON SYSTEMS
Ar–chlorotrifluoromethane, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
Ar–ethanol, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)
Ar–He–Ne, striation production in hollow-cathode plasma at, (E), 20: 20085
Ar–Hg, r-f resonance measurement of electric conductivity of discharge plasma of, 20: 20088
Ar–K, electron temperatures in hot discharge plasma of, (E), 20: 20024
Ar–K, electron temperatures in crossed-field flow of plasma of, (T), 20: 20076
Ar–SF_6, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
ARGONNE ADVANCED RESEARCH REACTOR
criticality studies, 20: 20200(R) (ANL-7110, pp 29-98)
kinetics calculations, 20: 20200(R) (ANL-7110, pp 29-98)
ARGONNE THERMAL SOURCE REACTOR
reactivity measurements in, 20: 20200(R) (ANL-7110, pp 29-98)
ARMY REACTORS (ML-1)
shielding design concepts for, 20: 20227 (AGN-TM-412)
ARMY REACTORS (PM-1)
instrumentation development for, 20: 20242 (NYO-3379-3)
ARMY REACTORS (PM-2)
instrumentation development for, 20: 20242 (NYO-3379-3)
ARMY REACTORS (PM-3)
instrumentation development for, 20: 20242 (NYO-3379-3)
ARSENATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
ARSENIC
separation from other fission products, rapid, 20: 18838
ARSENIC ISOTOPES
gamma spectra and delayed neutron emission from, 20: 18838

ARSENIC ISOTOPES As-74
decay of, branching ratios for electron-capture, (E), 20: 19831 (NP-15912)
ARSENIC ISOTOPES As-76
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
ARSENITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
radiolytic oxidation of aqueous solutions of, effects of osmium tetroxide on, 20: 18790
ARSINE OXIDE, TRIPHENYL-
properties as analytical reagent, 20: 18607
ARTHROPODS
radiation effects on milliped, gamma, 20: 18366
ASCORBIC ACID
radiosensitivity effects on yeast, 20: 18503 (AD-611869, pp 169-83)
ASTRONAUTS
radiation dose estimates for Apollo, 20: 18190(R) (UCRL-16613)
ASTROPHYSICS
solar-flare prediction using perceptrons, 20: 19324 (N-65-21300)
ATHEROSCLEROSIS
development in monkeys, effects of chondroitin sulfate on, 20: 18295(R) (UCLA-12-576, pp 27-56)
ATLANTIC OCEAN
strontium-90 vertical exchange in, 20: 18930
ATMOSPHERE
analysis for radon-219, series decay chamber for, 20: 18904
carbon-14 content during 1965, effects of nuclear explosions on, 20: 18917
carbon-14 content during last six millennia, fluctuation of, (E), 20: 19683
carbon-14 content in, geomagnetic field effects on, (E), 20: 19684
detonation wave propagation in refracting, yield-scaling factors for, (T), 20: 19618 (SC-RR-65-369)
fallout monitoring of, autoradiographic, 20: 18916
geochemistry of bromine, chlorine, and iodine in, over Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
ion-molecule reactions at low energies in, absolute cross sections for charge transfer, (E), 20: 19670
isotopic variations of deuterium and oxygen-18 in marine, 20: 18896 (NYO-3450-1, pp 277-374)
model for, three-dimensional, (T), 20: 19646 (SC-DC-65-1701)
properties of upper, model for solar-activity and local-time dependent variation of neutral, 20: 19650
radioactivity in, 1965, 20: 18914
radioactivity in, 1965, 20: 18915
radioactivity in, 1965, 20: 18918
radioactivity in, along 80th meridian (west) 1964, 20: 18967
radioactivity in, Jan. to July, 1965, 20: 18972
radioactivity in, 1963 to 1965, 20: 18980
sampling equipment for, 20: 18988(R) (ORNL-929, pp 58-66)
ATOMIC BEAMS
electron beam reactions with polarized, spin-exchange, (E), 20: 19375
ATOMIC ENERGY
development and uses in Soviet Union, 20: 20182(T) (AEC-tr-6700)
uses in research, review, 20: 20367
ATOMIC ENERGY COMMISSION
hearings on Federal Radiation Council Protection Guides, June, 1965, 20: 18980
report to Congress for 1965, supplemental, 20: 20364
ATOMIC ENERGY, LEGAL ASPECTS
conference on insurance, 20: 18939 (EUR-2642.f)
medical radium control in Pennsylvania, 20: 18981
radium management at the county level, 20: 18982
ATOMIC EXPLOSIONS
effects on content of carbon-14 in atmosphere during 1965, 20: 18917
electromagnetic pulse from, system for simulation of, 20: 19109 (N-65-21743)
radio waves from, computer programs for calculating, 20: 18927 (RM-4942(RAND))
use in geology, bibliography on, 20: 18855 (CEA-Bib-66)
ATOMIC PHYSICS
bibliography on high-energy, 20: 19804 (AED-C-12-13(Pt.2))
ATOMS
channeling of energetic, in solids, 20: 20365
chemical bonds between metal, 20: 20365
electron scattering by, review of theories for resonances in, 20: 19361
electron scattering at low energies, relativistic effects in, (T), 20: 19397
electron spectra of $10 \leq Z \leq 36$, KLL Auger, (T), 20: 19406
ionization by high-energy electrons, single and double, (T), 20: 19398
photon absorption by, review of theories for resonances in, 20: 19361
spectra of ionized, in Van de Graaff beam, (T), 20: 19402
wave equation for two-electron, symmetric decomposition of, 20: 19362
wave equations for, continuous spectrum of Schroedinger operators for, 20: 19364
ATTAPULGITES
crystal structure and properties of, for organic coolant purification, 20: 18625 (EUR-2646.e)
AUDITORY ORGANS
effects of labyrinth, combined with γ radiation on rabbit nervous system, 20: 18338
radiation effects on rabbit, sieve-controlled x, 20: 18357
AURORAL STORMS
luminosity pulsations in, analysis of, (E/T), 20: 19690
luminosity pulsations in, correlation with energy spectra of electrons, 20: 19691
occurrence at Byrd Station, Antarctica in winter 1962, (E), 20: 19641 (N-65-21748)
occurrence of, correlation with asymmetrical form of magnetosphere, 20: 19688
radar echoes of, correlation with storm sudden commencements, 20: 19661
structure of sub-, correlation with polar electrojet, (E), 20: 19657
x-ray emission in, microburst, 20: 19665
AUSTRALIA
sulfur isotope content in volcanic materials from, 20: 18909
AUSTRIA
strontium content in Triassic reef in Alps in, theory of recrystallization mechanism from, 20: 18631 (NYO-2266-1)
AUTORADIOGRAPHY
methods for studies on regeneration of intestinal epithelium, 20: 18291(R) (N-65-17058)
of skeletal aging, growth, and repair, 20: 18185(R) (BNL-929, pp 126-47)
use for analysis of fallout for gross β activity and number of radioactive particles, 20: 18916
use in determining tritium gas bubble behavior in aluminum–lithium alloys, 20: 19265
AUXINS
analogs of, cytotoxic effects on ascites tumors, 20: 18426

B

BACTERIA
content of bacteriochlorophyll-protein complexes in, 20: 18184(R) (BNL-929, pp 115-25)
effects of radiomimetic substances on, protective effects of thiol compounds against, 20: 18481
radiation effects on *Diplococcus pneumoniae* during transformation, uv, 20: 18320
radiation effects on spores of *Bacillus cereus*, x, 20: 18344
radiation effects on spores of *Bacillus megaterium*, effects of hydrogen sulfide and nitric oxide on, 20: 18434
radiation effects on metabolism and viability of *Staphylococcus aureus*, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiation effects on DNA in *Micrococcus radiodurans*, 20: 18269
radiation effects on sulfhydryl content of *Serratia marcescens* cells, x, 20: 18448
radiation effects on, protective effects of thiol compounds against x, 20: 18481
radiosensitivity effects of toxins from, in mice, 20: 18425
radiosensitivity of, effects of carotenoid pigments on, 20: 18361
radiosensitivity of, effects of iodoacetamide on x, 20: 18446
radiosensitivity of *Serratia marcescens*, effects of cysteine and oxygen on x, 20: 18448
BACTERIOPHAGES
infection of *Escherichia coli* by, mechanism of, 20: 18204(R) (LA-3432, pp 130-77)
radiation effects on *E. coli* replication of RNA, uv, 20: 18316
radiation effects on, combined with vibrations in *E. coli*, γ, 20: 18363
radioinduced in *E. coli*, cosmic and γ, 20: 18363
separation of DNA from, 20: 18190(R) (UCRL-16613)
structure of $\phi\chi 174$, 20: 18184(R) (BNL-929, pp 115-25)
BALTIC SHIELD (EUROPE)
lead isotopic composition in, geochemical significance of, 20: 18894 (NYO-3450-1, pp 169-84)
BARBITURIC ACIDS
radioinduced ESR spectra monocrystals of dihydrate of, 20: 18755
BARIUM
diffusion in synthetic zeolites, tracer studies of kinetics of self-, 20: 18686
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
separation from rare earths by ion exchange chromatography, 20: 18827
BARIUM CARBONATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

use of kryptonated, for determining sulfate ion in aqueous solutions, 20: 18570(R) (NYO-2757-5)

BARIUM CHLORIDES
sorption by glass surfaces, 20: 18846

BARIUM COMPLEXES
with 2,6-pyridinedicarboxylic acid, ion exchange properties of, 20: 18685

BARIUM IONS
exchange with ammonium and sodium ions on zeoloite, thermodynamics of, 20: 18629(R) (NP-15353)

BARIUM ISOTOPES
isotopic mixing constants of, volume, (T), 20: 19970

BARIUM ISOTOPES Ba-133
energy level transitions in, use of lithium-drifted germanium detector for high resolution of, 20: 19087
plasma and renal clearance in man, 20: 18226

BARIUM ISOTOPES Ba-135
energy levels of, structure from isomeric transition in, (T), 20: 19970

BARIUM ISOTOPES Ba-137
energy levels of, structure from isomeric transition in, (T), 20: 19970

BARIUM ISOTOPES Ba-139
uses for determination of sulfur in biological materials by sulfate precipitation and gamma counting, 20: 18609

BARIUM ISOTOPES Ba-140
content in diet in U. S., 1961 through 1964, 20: 18920

BARIUM NITRATES
sorption by glass surfaces, 20: 18846

BARIUM PERCHLORATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
use of kryptonated, for determining water in organic liquids, 20: 18570(R) (NYO-2757-5)

BARIUM STRONTIUM TITANATES
superconductivity in, (E), 20: 19767

BARIUM SULFATES
precipitation with strontium in contaminated solutions, 20: 18579 (UJV-1489)
$BaSO_4$–$CaSO_4$, sorptive properties for strontium, 20: 18835

BARIUM URANATES
crystal structure of Ba_3UO_6, 20: 19223

BARLEY
radiation effects on chromosomes in, mechanism for γ and fast-neutron, 20: 18355
radiation effects combined with magnetic fields on seeds of, x, 20: 18387
radiation effects on seeds of, effects of seed water on oxygen effect on gamma, 20: 18389
radiation effects on, mutagenic, 20: 18409
radiation effects on seedlings and seeds of, x, 20: 18411
radiation effects on seeds of, protective effects of carbonates and phosphates against x, 20: 18435
radioinduced mutants of, use in plant breeding programs of x, 20: 18418
radioresistance in, induction of x, 20: 18411

BARYONS
decay amplitudes in quark model for, nonleptonic, 20: 19576
form factors from SU(3) ● SU(3) ● U(1) group, weak leptonic, 20: 19590
form factors in collinear U(6), $\omega\phi$ mass-splitting effects on electromagnetic, 20: 19572
interactions in $\bar{U}(12)$ symmetry, electromagnetic, (T), 20: 19568
interactions with mesons (π) and photons, coupling constants for, (T), 20: 19539 (JINR-E-2544)
interactions with bosons, Lee model for, 20: 19557
interactions with mesons, SU(6) predictions for, 20: 19579

BARYONS, RESONANCE
decay widths for, (T), 20: 19539 (JINR-E-2544)
detection of $\bar{N}^*_{3/2, 3/2}$, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions of N* with nucleons, p-wave analysis of, 20: 19476
mass and width of Y*, (T), 20: 19471
mass of $\frac{5}{2}^+$ multiplet of, structure for, (T), 20: 19519
masses of $\frac{7}{2}^+$ and $1\frac{1}{2}^+$ multiplets, (T), 20: 19519
model for N*(1238), bootstrap with nucleons in self-consistent, 20: 19457
model for, quark, (T), 20: 19531
production of N* in nucleon interactions, p-wave analysis of, 20: 19476
production of N* in nucleon–nucleon interactions, peripheral model for, 20: 19477
production of Y_1^*, in meson (π^-) interactions with protons, (T), 20: 19469
review, 20: 19530

BEANS
radioinduced chromatid aberrations in root-meristem cells of, dose-response parameters for x, 20: 18350
radioinduced mutations of, use in plant breeding programs, 20: 18419
use as radiation dosimeter during space flight, 20: 18964

BEARING MATERIALS
development for space applications, 20: 18891

BEARINGS
friction of, in space vacuum at high temperatures, 20: 18891

BEHAVIOR
effects of magnetic fields on Drosophila, 20: 18410
radiation effects on rat avoidance, x, 20: 18339
radiation effects on milliped, gamma, 20: 18366
radiation effects on mouse and rat, γ, 20: 18376
radiation effects combined with magnetic fields on Drosophila, gamma, 20: 18410
radiation effects on conditioned and avoidance, of primates, 20: 18283 (AD-611869, pp 375-89)

BELGIAN REACTOR-2
radioisotope production in, 20: 19139

BENZALDEHYDE, *m*-HYDROXY-
critical solution temperature in light and heavy water, deuterium effects on, 20: 18720

BENZALDEHYDE, *p*-HYDROXY-
critical solution temperature in light and heavy water, deuterium effects on, 20: 18720

BENZAMIDE
derivatives, radiosensitivity effects in mice, 20: 18478

BENZENE
determination in irradiated terphenyl, method for, 20: 18560 (EUR-2454.f)
effects on radiolysis of solid deuterated cyclohexane, 20: 18733
effects on radiolytic isomerization of stilbene, 20: 18735
labeling with carbon-14, 20: 18710
labeling with tritium by reaction of recoil tritium with benzene, 20: 18814
preparation from acetylene for use in radiocarbon age estimation, catalyst for, 20: 18710
preparation from carbon-14-labeled acetylene, catalyst and equipment for, 20: 18933
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
reactions with recoil tritium, yields from, 20: 18814
benzene–CCl_4, radiolysis yields in, 20: 18730 (UJV-1468)

BENZENE, BROMONITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)

BENZENE, CHLORONITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)

BENZENE, HEXAMETHYL-
neutron scattering by solid, rotational motion and phase transition studies by, 20: 18717

BENZENE, NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)

BENZENE, 1,3,5-TRIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

BENZENESULFONIC ACID
solvolysis of, in water, isotope effects on, 20: 18643

BENZOHYDROXAMIC ACID, *N*-PHENYL-
solvent properties for niobium and zirconium, 20: 18586
uses for spectrophotometric determination of niobium and zirconium, 20: 18586

BENZOIC ACID, *m*-NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)

BENZOPHENONE
electrochemical reduction in ethanol–water system at 0 to 40°C, effects of buffer system on, 20: 18636(R) (TID-22725)

3,4-BENZOPYRENE
radioinduced linkage to DNA, x, 20: 18788

BENZOQUINONE, 2,5-BIS(METHOXYETHOXY)-3,6-BIS(ETHYLENIMINO)-
effects on rat erythropoiesis, effects of erythropoietin on, 20: 18500

BENZYL ALCOHOL, α-(AMINOMETHYL)-*p*-HYDROXY-
hydrochloride, labeling with carbon-14, 20: 18709

BEPO
operation and maintenance of, problems in, 20: 20323

BERYLLIUM
abundance in F- and G-type dwarf stars, lithium/beryllium value from, (E), 20: 19330
density measurements of, liquid media for, 20: 19219 (RFP-691)
effects of dissolved, on plant growth, 20: 18211(R) (UCLA-12-576, pp 88-111)
effects on thorium dioxide–uranium dioxide fuel particle solubility in fluoride–nitric acid solutions, 20: 18819 (AAEC/E-143)
electron beam scattering by thick targets of, retrofugal flux from, (E),

20: 19394
electron correlation, pair approximation, and augmented expansion for atomic, (T), 20: 19357 (IS-T-64)
energy gap and Fermi surface in, (E/T), 20: 20167
fabrication of thin-walled shapes of, process development for plasma spray, 20: 19198
failure of bubble chamber windows of, 20: 19038 (NYO-10742)
friction properties of, *in vacuo*, relation of lattice parameter to, 20: 19206 (N-65-17331)
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
neutron cross sections, 20: 19844 (WANL-TME-1228)
neutron elastic scattering by, fast, 20: 19805(R) (ANL-7110, pp 1-28)
neutron scattering by, thermal, (T), 20: 19781 (JAERI-1095)
neutron scattering by, cross sections for slow, (E/T), 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
oxidation of 1450 to 1500°C, crystal structure of oxide whiskers formed in, 20: 19194
positron annihilation in, (E), 20: 20167
properties of, effects of purity on electric and superconducting, 20: 19737
proton reactions at 0.5 to 2 Bev, neutrons from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
radiation effects on mechanical properties of, fast-neutron, 20: 19178(R) (IDO-17154)
separation from rare earths by ion exchange chromatography, 20: 18827

BERYLLIUM ALLOYS
Al–Be, corrosion by water at 163°C, effects of beryllium content on, 20: 19178(R) (IDO-17154)
Be–Cu, lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363

BERYLLIUM ISOTOPES Be-7
solvent distribution between bis(2-chloroethyl) ether and hydrochloric acid, coefficient of, 20: 18571 (ORNL-TM-1420)

BERYLLIUM ISOTOPES Be-8
alpha emission, parities at 9 to 16 Mev for, (E), 20: 19273(R) (BNL-929, pp 3-43)
energy level of, isotopic spin mixing at 16.62- and 16.92-Mev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of, reduced widths for, (T), 20: 19822 (JINR-P-2301)
energy levels of, isobaric spin mixing in, (T), 20: 19919

BERYLLIUM ISOTOPES Be-9
alpha reactions (α,d) and (α,t) at 28.6 Mev, momentum spectra from, (E), 20: 19876
deuteron reactions (d,n) at 2.6 to 7.0 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
energy levels of, reduced widths for, (T), 20: 19822 (JINR-P-2301)
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901

BERYLLIUM ISOTOPES Be-10
energy levels of, reduced widths for, (T), 20: 19822 (JINR-P-2301)

BERYLLIUM OXIDES
neutron scattering by, cross sections for slow, (E/T), 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
performance for insulating in-pile thermocouples, 20: 20185 (CONF-650204-9)
preparation and structure of single-crystal whiskers of, 20: 19194
sorptive properties for hydrogen at 300 to 500°C, 20: 18688
Al–BeO–UO_2, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
BeO–PuO_2–ThO_2, fabrication of dispersions of, process development for, 20: 19177(R) (BMI-1757)

BETA DECAY
gamma radiation accompanying, continuous, (T), 20: 19949
helicity of, momenta dependence of, (E/T), 20: 19806 (ANL-7130, pp 313-25)
ionization from, direct interaction mechanism for, (T), 20: 19934
theory of, isobaric spin conservation in, 20: 19837 (UCRL-14750-T)
theory of, reviews on, 20: 19459

BETA PARTICLES
attenuation by plant materials, use in estimation of forage yields, 20: 19119
dosimetry in bones, review of experimental and theoretical methods for, 20: 18954
dosimetry of, from strontium-90–yttrium-90 irradiator, 20: 18522
dosimetry of, in ceramic coatings, 20: 18974
effects in Drosophila, genetic, 20: 18332
effects on blood picture in mice, 20: 18353
effects on cardiac function, 20: 18328
effects on cutaneous angiomas, 20: 18528
effects on jute plants, genetic, 20: 18385
effects on metabolism in yeast, 20: 18372
effects on mouse chromosomes, 20: 18286 (EUR-2462.1)
effects on pituitary gland, 20: 18532
effects on polycythemia, 20: 18525
effects on polycythemia, 20: 18527
effects on rat leukocytes, protective effects of B vitamins against, 20: 18499
effects on resistance transfer factor episome in *E. coli*, inactivation, 20: 18254
effects on seeds of corn, lupine, turnips, and wheat following soaking in phosphorus-32 solutions, 20: 18442
effects on silicon single crystals, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
effects on wheat seed, genetic, 20: 18322
scattering by promethium-147, use for measuring metallic corrosion, 20: 19196
scattering of, ash content measurements in coal samples by, 20: 18596

BETA SOURCES
determination in expired breath, design of electrometer for, 20: 18235
measurement simultaneously with alpha sources, proportional detector pair for, 20: 19058
monitor for, design and performance of, 20: 19065
use of phosphorus-32, for therapy of polycythemia, 20: 18554

BETA SPECTROMETERS
design, 20: 18198
energy range extension, (E/T), 20: 19273(R) (BNL-929, pp 3-43)

BETATRONS
uses for inspection of welds in thick steel plates, 20: 19233

BIBLIOGRAPHIES
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on analytical chemistry methods used at ORNL, 20: 18575 (TID-7015 (Indexes)(Rev.3))
on biological and chemical effects of deuterium and its compounds, 20: 18214
on chemical reactions of radioisotope-containment materials with launch pad abort combustion gas species, 20: 19192 (SC-DR-65-1918)
on complex angular momentum in elementary-particle scattering, 20: 19596
on crystal-diffraction techniques for neutron scattering experiments, 20: 19795
on Earth's atmosphere, 20: 19646 (SC-DC-65-1701)
on electron capture cross sections and negative ion lifetimes, 20: 18557 (ORNL-TM-1409)
on geologic applications of nuclear explosions, 20: 18855 (CEA-Bib-66)
on high-energy physics, 20: 19803 (AED-C-12-13(Pt.1))
on high-energy physics, 20: 19804 (AED-C-12-13(Pt.2))
on high-temperature chemistry and physics of gases and plasmas, 20: 18630 (NP-15896)
on high-temperature chemistry and physics of materials in condensed state, 20: 19216 (NP-15388)
on iron/manganese accumulations in shallow marine environment, 20: 18895 (NYO-3450-1, pp 217-76)
on liquid-metal-cooled reactors, 20: 20237 (EURFNR-42F)
on magnetic inelastic scattering of neutrons, 20: 19797
on mechanical and time-of-flight techniques for neutron inelastic scattering, 20: 19794
on meson (π)–meson (π) and meson (π)–nucleon interactions, 20: 19522
on neutrinos, 20: 19445 (NEIC-RR-20)
on neutron scattering by liquids, (E), 20: 19799
on neutron scattering by molecules, (E), 20: 19801
on nuclear magnetic resonance studies of molecular motions in solids, 20: 18672
on nuclear safety, 20: 18945 (ORNL-NSIC-14)
on plutonium, 20: 20355 (BNWL-113-12)
on plutonium, 20: 20356 (BNWL-113-13)
on preparation and properties of rare gases and their compounds, 20: 18623 (CEA-Bib-58)
on production and industrial uses of radiation and radioisotopes, 20: 19117 (ORNL-TM-1356(Suppl.1))
on production of uranium-232 by irradiation of protactinium-231, 20: 18802 (CEA-R-2917)
on relativistic S-matrix theory, 20: 19593
on solid lubricants, 20: 19215 (NASA-SP-5037)
on strong interactions at high energies, 20: 19609
on thermal conductivity of cryogenic liquids, 20: 19614 (N-65-17283)
on thermal neutron scattering in liquids and solids, 20: 19793
on thermal neutron detectors and sources, 20: 19796
on thermal neutron scattering by liquids, 20: 19798
on thermal vibrations of crystal lattices, 20: 20170
on use of secondary nuclear reactions in radiochemistry, 20: 18807

BILE
role in gastrointestinal syndrome of radiation sickness, 20: 18327(T)
BINDING ENERGY
theory of nuclear matter, 20: 19983
BIOLOGICAL MATERIALS
analysis by activation methods, Szilard-Chalmers effect in, 20: 18583
analysis for sulfur by precipitation using barium-139 and gamma counting, 20: 18609
beta attenuation by plant, estimation of forage yields using, 20: 19119
effects of deuterioorganic compounds on, 20: 18214
radiation effects on, correlation with dose and exposure, 20: 18951
use as radiation dosimeter during space flight, 20: 18964
BIOLOGICAL SYSTEMS
effects of cystamine and cysteamine on, biochemical, 20: 18453
for testing radioprotective compounds, 20: 18485
photosensitivity of, effects of furocoumarins on, 20: 18466
radiation injuries of, role of molecules in, 20: 18274
radiation protection in, reaction mechanisms for, 20: 18274
radioactive material distribution in compartmental, stochastic model for, 20: 18427 (ORNL-3920)
reactions in, AET–free radical, 20: 18479
BIOLOGY
research programs on, at Argonne Cancer Research Hospital, 1965, 20: 18422(R) (ACRH-24)
stable isotope uses in, 20: 19120
BIOSYNTHESIS
genetic regulation of leucine, in Neurospora, 20: 18196
BIOTITES
shock-pressure effects on mechanical and optical properties of, Hardhat event, 20: 18856
BIPHENYL
effects on radioinduced thermoluminescence of cyclohexane and ethanol, 20: 18760
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
BISMUTH
determination of, using triphenylarsine oxide, 20: 18607
neutron activation at 14.4 Mev, (E), 20: 19809 (CEA-R-2900)
BISMUTH ALLOYS
Bi–Cd–Pb–Sn, preparation of kryptonates of Wood's metal by diffusion, 20: 18570(R) (NYO-2757-5)
Bi–In, bismuth-209 NMR in liquid, 20: 20157
Bi–In, indium-115 NMR in liquid, 20: 20157
Bi–Pb, magnetic hysteresis loops in superconducting, (E), 20: 19741
Bi–Pb, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745
Bi–Pb, power losses in superconducting eutectic, surface nature of a-c, (E), 20: 19742
BISMUTH CHLORIDES
radiation effects on sedimentation rates in, 20: 18792
BISMUTH ISOTOPES Bi-207
beta decay of, lead-207 levels from, (E), 20: 19846
BISMUTH ISOTOPES Bi-208
production of isomeric, in neutron activation of bismuth at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
BISMUTH ISOTOPES Bi-209
nuclear magnetic resonance in liquid binary alloys, 20: 20157
BISMUTH ISOTOPES Bi-210
content in cigarettes, 20: 18965
BISMUTH ISOTOPES Bi-212
alpha decay of, recoil-atom charge from, (E), 20: 19867
BISMUTH OXIDES
properties for use in preparation of rare earth chromites from fluxed melts, 20: 18654
BLACK SEA
radium-226 content in, 20: 18905
BLOOD
analysis by activation methods, Szilard-Chalmers effect in, 20: 18583
cytology of human, 20: 18185(R) (BNL-929, pp 126-47)
irradiation of, of leukemia patients, extracorporeal, 20: 18198
radiation effects on, clinical uses of extracorporeal, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on steroid content of burro's, neutron, 20: 18296(R) (UCLA-12-576, pp 57-60)
radiation effects on serotonin levels in rabbit, x, 20: 18257
radioinduced changes in, of cancer patients, 20: 20360(R) (PRNC-73)
strontium-90 content in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
BLOOD CELLS
counting of, electronic equipment for, 20: 18186(R) (LA-3432, pp 102-29)
separation by volume, electronic, 20: 18186(R) (LA-3432, pp 102-29)
size distribution in cultures, measurements of, 20: 18297(R) (UCLA-12-576, pp 81-8)
BLOOD CIRCULATION
effects of adrenaline on, in cats, 20: 18296(R) (UCLA-12-576, pp 57-60)
tracer study of brain and lung, 20: 18509(R) (UCLA-12-576, pp 61-80)
BLOOD COAGULATION
radiation effects on, β, 20: 18527
BLOOD FORMATION
radiation effects on mouse, protective effects of intestinal shielding against x, 20: 18432
radiation effects on human, after radiotherapy of genital and mammary carcinomas, 20: 18552
BLOOD PICTURE
radiation effects on, of man, x, 20: 18381
radiation effects on human, after cancer therapy, 20: 18244 (NIJS-R-467)
radiation effects on mouse, x, 20: 18285 (AD-630103)
radiation effects on, 20: 18519
BLOOD PLASMA
barium-133 clearance from human, 20: 18226
calcium-47 clearance from human, 20: 18226
gamma counting rate in rabbit, effects of biological differentiation of molybdenum-99 and technetium-99 on, 20: 18213
radiotherapy of myelomas of, x, 20: 18551
radium-223 clearance from human, 20: 18226
strontium-85 clearance from human, 20: 18226
BLOOD PRESSURE
effects of acetylcholine and adrenaline on rat, effects of AET and cysteamine on, 20: 18239
effects of genetics and sodium salts on rat, 20: 18185(R) (BNL-929, pp 126-47)
BLOOD SERUM
radiation effects on nitrogen content and proteins in frog, gamma, 20: 18243 (NIJS-R-454)
radiation effects on glycoprotein content in rat, x, 20: 18258
BLOOD VESSELS
radiation effects on rabbit, sieve-controlled x, 20: 18357
radiation effects on abdominal and renal, following tumor therapy during infancy, 20: 18398
radiation effects on rabbit heart, x, 20: 18456
BODY WATER
effects of AET on, in rats, 20: 18458
BOILERS
development for reactors, 20: 20183
stress analysis of EGCR, 20: 20249 (TID-22738)
BOILING
burnout heat flux in 19-rod bundle with subcooled water and fog, 20: 18860 (BNWL-206)
burnout in fuel rod clusters, methods for detecting onset of, 20: 18859 (AEEW-R-432)
heat transfer by liquid metals, 20: 18870(R) (SAN-409-28)
heat transfer in two-phase flow, model for, (T), 20: 18863 (EURAEC-1360)
hydrodynamic stability of natural circulation systems, models for, (E/T), 20: 18871 (STL-372-14(1))
phase velocity distribution in flow system, (T), 20: 18874
properties of subcooled, high-pressure loop for determining, 20: 18872(R) (STL-372-27, pp 13-21)
BOILING REACTORS
coolant flow and heat transfer in, 20: 20263 (TID-22758)
coolant flow instabilities in, models for, (E/T), 20: 18871 (STL-372-14(1))
coolant void fraction determination using simulated boiling in exponential piles, (E), 20: 20216
coolant voids in, acoustic methods for determining, 20: 20187 (EURAEC-1361)
fuel temperature distributions in operating, (T), 20: 20190
kinetics of, space-dependent, 20: 20200(R) (ANL-7110, pp 29-98)
operation with superheating lattices, physics problems of, 20: 20275
reactivity of, computer program for calculating, 20: 20208 (RT/FI-(65)51)
stability of, method and equipment for calculating, 20: 20236(R) (EURAEC-1561)
BONDS, CHEMICAL
effects of hydrogen, on uranium distribution in aqueous carboxylic acid–TBP, 20: 18845
BONE FRACTURES
radioinduced in femoral neck following therapy for gynecologic cancer, x, 20: 18407
BONE MARROW
effects of cyclohexanol succinate on, effects of lysozyme on, toxic, 20: 18470
effects of injected syngeneic, on urethan-induced leukemogenesis in newborn mice, 20: 18191
effects of transplants of, on erythropoietic activity of spleen in lethally irradiated mice, 20: 18295(R) (UCLA-12-576, pp 27-56)
effects on leukemia incidence in mice, 20: 18317
radiation effects on mitosis in rat, protective effects of sodium against

x, 20: 18326
radiation effects on chromosomes in mouse, after distant exposure, 20: 18356
radiation effects on mouse, γ and proton, 20: 18364
radiation effects on cell reproduction in mouse, survival curve analysis of γ, 20: 18370
radiation effects on, of man, x, 20: 18381
radiation effects on mouse, combined with acceleration or vibration, 20: 18439
radiation effects on rat, effects of radiomimetic substances on x, 20: 18534
radiosensitivity effects of lyophilized extracts of calf, in rats, 20: 18497
radiosensitivity of, effects of cyclohexanol succinate and lysozyme on, 20: 18494
BONE TUMORS
radiodiagnosis using strontium-85, 20: 18513
BONES
calcium-45 uptake by, effects of cortisone on, 20: 18480
effects on radiation dosimetry in surrounding tissue, 20: 18978
phosphorus-32 incorporation in, effects of radioprotection compounds on, 20: 18479
radiation dosimetry in trabecular, 20: 18953
radiation dosimetry in, review of experimental and theoretical methods for, 20: 18954
radiation effects on, following radium therapy of cervical cancer combined with telecobalt or x rays, 20: 18309
strontium-90 content in, 1964 and 1965, 20: 18914
strontium-90 content in human, in Scotland and United Kingdom, 20: 18922
strontium-90 content in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
sulfur-35 incorporation in, effects of radioprotective compounds on, 20: 18479
BORATE GLASS
radiation effects on ESR spectra of, gamma, 20: 19256(R) (NYO-2024-9)
BORATES
effects on polarographic reduction of benzophenone in ethanol–water system, 20: 18636(R) (TID-22725)
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
BORIDES
molecular structure of trivalent, 20: 18556(R) (BNL-929, pp 66-82)
BORON
abundance in sun, photometric scan for determining, (E), 20: 19331
analysis for impurities, spectrochemical procedures for, 20: 18568(R) (NBL-230)
analysis for impurities, activation, 20: 18568(R) (NBL-230)
analysis for impurities by x-ray spectrography, performance of chromium and tungsten target tubes for, 20: 18568(R) (NBL-230)
determination in aluminum–boron mixtures, methods for, 20: 18568(R) (NBL-230)
determination in germanium and silicon by deuteron or proton activation, 20: 18582
determination in presence of nitrogen by proton activation, 20: 18582
determination in uranium dioxide, methods evaluation for, 20: 19253(R) (CEND-3107-261)
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in graphite, thermal, 20: 20365
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
preparation of known-impurity, for standards, 20: 18568(R) (NBL-230)
BORON CARBIDES
Al–B_4C–U_3O_8, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
BORON FLUORIDE COMPLEXES
with anisole and hydrofluoric acid in nickel corrosion tests, ir spectral studies on, 20: 19135(R) (K-C-718)
BORON FLUORIDES
anisole–BF_3, corrosive effects on metals and polymers, 20: 19135(R) (K-C-718)
anisole–BF_3, physical properties, 20: 19135(R) (K-C-718)
BORON HYDRIDES
preparation of, for use in conversion of acetylene to benzene, 20: 18933
BORON IONS
reactions with silicon at 10 to 80 kev, production of electric junctions by, (E), 20: 20123
BORON ISOTOPES
determination of, mass spectrometric procedure for, 20: 18568(R) (NBL-230)
exchange between anisole and boron trifluoride, engineering-scale test unit for, 20: 19135(R) (K-C-718)
BORON ISOTOPES B-9
energy levels from boron-10 (He-3,α) reactions, low-lying positive-parity, (E), 20: 19907
BORON ISOTOPES B-10
determination by neutron absorption, 20: 18568(R) (NBL-230)
energy level transitions from lithium-6 (α,γ) reactions, strength of, (E), 20: 19911
energy levels of, reduced widths for, (T), 20: 19822 (JINR-P-2301)
helium-3 reactions (He-3,α) at 5.5 Mev, angular distributions from, (E), 20: 19907
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
neutron capture by cell mixtures of, local effects of, 20: 20360(R) (PRNC-73)
neutron capture cross section, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron cross sections, 20: 19844 (WANL-TME-1228)
production in alpha reactions (α,t) with beryllium-9 at 28.6 Mev, level population in, (E), 20: 19876
recovery from scrap, methods for, 20: 18568(R) (NBL-230)
use in neutron capture therapy, 20: 18507 (BNL-10009)
BORON ISOTOPES B-11
alpha reactions (α,t), angular distributions from, (T), 20: 19967
energy levels of, (E), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of, reduced widths for, (T), 20: 19822 (JINR-P-2301)
production in alpha reactions (α,d) with beryllium-9 at 28.6 Mev, level population in, (E), 20: 19876
BORON ISOTOPES B-12
beta decay of, matrix elements for, 20: 19940
production in neutron activation of carbon at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
BORON NITRIDES
surface temperature of, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
BORON OXIDES
reactions with carbon and oxides to prepare borides, 20: 19702
B_2O_3–KCl, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
B_2O_3–KF, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
B_2O_3–Li_2O, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
B_2O_3–NaCl, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
B_2O_3–NaI, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
B_2O_3–PbO, properties for use in preparation of rare earth chromites from fluxed melts, 20: 18654
BOROSILICATE GLASS
sorptive properties for cesium, 20: 19422 (N-65-26628)
BOSONS
density fluctuations in superfluid system of, correlation of, (T), 20: 19768
interactions in hard sphere gas of, method of point transformations for, 20: 19633
interactions with baryons, Lee model for, 20: 19557
photoproduction, (T), 20: 19447 (UCRL-14614-T)
production of intermediate (W), in high-energy neutrino reactions, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
properties of gases of, 20: 19468
research on intermediate, 20: 20365
BRAIN
blood flow in, tracer study, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiation effects on reflex mechanisms in rabbit, γ, 20: 18338
radiation effects on myelin synthesis in rat, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiation effects on protein synthesis in stem of rat, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiosensitivity of, in mice and rats, 20: 18376
BRAIN TUMORS
radiotherapy using neutron capture, 20: 18508 (BNL-10038)
BRAKES
design of hydraulic, for reactor control rods, 20: 20194(P)
BRASS
corrosion by salt spray, measurement of, by x-ray induction method, 20: 19196
electric and thermal properties for use as thermometer below 1°K, 20: 19729
structure of beta-, 20: 20365
BREASTS
radiotherapy of carcinomas of, 20: 20360(R) (PRNC-73)
BREATH
analysis of expired, for α and β activity, design of electrometer for,

20: 18235
BREEDER REACTORS
design concepts for fast, physics of, 20: 20240 (LA-DC-7739)
development of metal-cooled, 20: 20183
development status, 20: 20282
BREMSSTRAHLUNG
effects on threshold detector performance, 20: 19111 (NP-15910)
emission by electrons, relation to Cherenkov radiation, (T), 20: 19[illegible]
production from electron precipitation in auroral-zone ionosphere, (E), 20: 19671
production in auroral-zone D region, energetic electron-precipitation determination from, (E), 20: 19672
production in proton-proton interactions at 204 Mev, cross sections for, (E), 20: 19452 (UR-875-126, Paper 4)
production in proton interactions with deuterons and protons at 140 Mev, cross sections for, (E), 20: 19496
reactions (γ,αn) with oxygen-16 at 25 to 65 Mev, yield functions for, (E/T), 20: 19819 (IS-T-45)
reactions with cadmium and silver, levels in photoactivation, (E), 20: 19865
reactions with uranium-238 at 5.2 to 9.25 Mev, fission product angular distributions from, (E), 20: 19830 (NP-15055)
BROMATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
BROMINE
content in ratio with chlorine and iodine in aerosols, atmosphere, and rainwater in Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
diffusion in graphite, 20: 20177(R) (BNL-929, pp 83-105)
isotopic exchange with potassium bromide, 20: 18695
neutron scattering by liquid, review on, (E), 20: 19799
BROMINE IONS
production of monovalent negative, by electron capture in bromohydrocarbons, (E), 20: 18557 (ORNL-TM-1409)
BROMINE ISOTOPES Br-82
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
BROMOHYDROCARBONS
electron capture by, (E), 20: 18557 (ORNL-TM-1409)
BROOKHAVEN ALTERNATING-GRADIENT SYNCHROTRON
beam preinjector for, emittance measurements on, 20: 19287 (BNL-10095)
development and operation of, summary for fiscal 1965, 20: 19285(R) (BNL-929, pp 44-57)
ion source for, emittance of duoplasmatron, (E/T), 20: 19288 (BNL-10096)
research programs, 20: 19273(R) (BNL-929, pp 3-43)
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
administration, operation, and technical services of, summary for 1965, 20: 20354(R) (BNL-929)
environs monitoring, 1965, 20: 18918
BROOKHAVEN SYNCHROTRON
development and operation of, summary for 1965, 20: 19285(R) (BNL-929, pp 44-57)
BUBBLE CHAMBERS
data analysis for, using digital pattern recognition, 20: 19045 (UCRL-16509)
data analysis for, digital automatic pattern recognition, 20: 19046 (UCRL-16510)
data from, equipment and methods for analysis of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
data processing for, performance of CERN, HPD, and IEP systems for, 20: 19023 (CERN-66-4)
data reduction from, computer program for quality control of, 20: 19044 (UCRL-16508)
design and development, 20: 20365
development and operation of Brookhaven 80-in., 20: 19273(R) (BNL-929, pp 3-43)
electron tracks in, measurement of bubble density along high-energy, 20: 19060
window failure of CEA hydrogen, 20: 19038 (NYO-10742)
BUBBLES
radioinduced formation in aluminum–lithium alloys, properties of neutron, (E), 20: 19265
BURROS
radiation effects on, pathological γ and neutron, 20: 18188(R) (ORO-635)
radiation effects on steroid content of blood of, neutron, 20: 18296(R) (UCLA-12-576, pp 57-60)
BUTADIENE
acrylonitrile–butadiene, radioinduced graft polymerization onto cellulose, 20: 18796(P)
butadiene–styrene, radioinduced grafting onto cellulose, 20: 18798(P)
BUTADIENE, CHLORO-
radioinduced polymerization of, effects of stabilizers on gamma, 20: 18795
BUTANE
reactions with deuterium and tritium ions, spectral studies on, 20: 18657
BUTANE, 2,3-EPOXY-
BUTANE, 2,3-EPOXY-
effects on Neurospora, utilization of mutagenic, 20: 18347
1,3-BUTANEDIONE, 4,4,4-TRIFLUORO-1-PHENYL-
solvent properties for niobium and zirconium, 20: 18833
1-BUTANOL
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
2-BUTANONE
determination in aqueous solutions by gas chromatography, 20: 18572 (PG-Report-690)
1-BUTENE
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742
2-BUTENE
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742
BUTYL PHOSPHATES
radiation effects on fuel process, prevention of, 20: 18800(P)
solvent properties for scandium, 20: 18832
carboxylic acid–TBP–H_2O, effect of hydrogen bonding on uranium distribution in, 20: 18845
dodecane–HNO_3–TBP–$UO_2(NO_3)_2$–H_2O, equilibrium relations for, for nitric acid-uranyl nitrate extraction, 20: 18844
BUTYRIC ACID, 4-HYDROXY-
radiosensitivity effects of compounds of, in mice, 20: 18490

C

CACODYLIC ACID, SODIUM SALT
properties as radiation dosimeter, 20: 18503 (AD-611869, pp 169-83)
CADARACHE REACTORS (RAPSODIE)
fuel element inspection equipment and procedures, 20: 20273(T) (ORNL-tr-985)
CADMIUM
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
effects on recrystallization of magnesium, 20: 19240
neutron elastic and inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
photoactivation of natural, excitation levels in nuclear, (E), 20: 19865
separation from rare earths by ion exchange chromatography, 20: 18827
CADMIUM ALLOYS
Bi–Cd–Pb–Sn, preparation of kryptonates of Wood's metal by diffusion, 20: 18571(R) (NYO-2757-5)
Cd–In, electron band structure and superconductivity of, 20: 19764
Cd–In, indium-115 NMR in liquid, 20: 20157
Cd–In–Ag, reactivity worths in water-moderated uranium oxide cores, 20: 20210 (WCAP-3269-39)
Cd–Mg, crystallization, 20: 19240
CADMIUM IONS
potentials of divalent, half-wave, 20: 20177(R) (BNL-929, pp 83-105)
precipitation with sphalerite from aqueous solutions, 20: 18631 (NYO-2266-1)
CADMIUM ISOTOPES Cd-109
content in rainwater, New Zealand, 1964, 20: 18911
half life, (E), 20: 19956
use as radiation source in x-ray fluorescence analysis of ores, 20: 18593
use for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
CADMIUM ISOTOPES Cd-110
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
CADMIUM ISOTOPES Cd-111
photoactivation of, excitation levels in, (E), 20: 19865
CADMIUM ISOTOPES Cd-112
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
CADMIUM ISOTOPES Cd-113
energy levels of, structure from isomeric transition in, (T), 20: 19970
CADMIUM ISOTOPES Cd-114
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
CADMIUM ISOTOPES Cd-115
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
CADMIUM SYSTEMS
Cd–H_2O, neutron scattering in, reaction rate curves for, (E/T), 20: 19776 (AE-223)

CADMIUM ZINC SULFIDES
radioinduced luminescence of manganese-doped, effects of infrared radiation on alpha, 20: 18738
CALCITES
geology and mineralogy of, in Providencia area, Zacatecas, Mexico, 20: 18631 (NYO-2266-1)
precipitation with magnesium, manganese, strontium, and zinc ions from aqueous solutions, 20: 18631 (NYO-2266-1)
solubility in cave waters, 20: 18631 (NYO-2266-1)
strontium content in crystals of, from lead–zinc deposits, 20: 18631 (NYO-2266-1)
CALCIUM
content in diet in U. S., 1961 through 1964, 20: 18920
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
content ratio to strontium-90 in mouse tissues after intraperitoneal or subcutaneous injection, 20: 18225
diffusion in synthetic zeolites, tracer studies of kinetics of self-, 20: 18686
effects of soil, on strontium-90 uptake by plants, 20: 18232
effects on plant uptake of strontium from soil, 20: 18303
effects on strontium uptake by plants, 20: 20360(R) (PRNC-73)
metabolism in man, 20: 18185(R) (BNL-929, pp 126-47)
radiosensitivity effects of milliped exoskeletal, gamma, 20: 18366
CALCIUM CARBIDES
use of kryptonated, for determining water in organic liquids, 20: 18570(R) (NYO-2757-5)
CALCIUM CARBONATES
$CaCO_3$–$MgCO_3$, precipitation with magnesium from aqueous solutions at high temperatures, 20: 18631 (NYO-2266-1)
CALCIUM COMPLEXES
with 2,6-pyridinedicarboxylic acid, ion exchange properties of, 20: 18685
CALCIUM FLUORIDES
sorption properties for krypton during evaporation and condensation, 20: 19255 (EUR-2749.e)
CALCIUM IODIDES
gamma photofractions for well-type scintillation crystals of, 20: 19076
CALCIUM ISOTOPES
nuclear charge distributions in, variation with mass number, (E), 20: 19936
separation and preparation of targets at ORNL calutron, 20: 19153
CALCIUM ISOTOPES Ca-37
half life, (E), 20: 20365
production and delayed proton emission by, 20: 18556(R) (BNL-929, pp 66-82)
CALCIUM ISOTOPES Ca-39
energy levels from proton reactions (p,d) with calcium-40 at 55 Mev, neutron-hole, (E), 20: 19877
CALCIUM ISOTOPES Ca-40
energy level transitions in, cross sections and matrix elements for E2, (T), 20: 19975
energy levels of, parity and spin of, (T), 20: 19816 (INP-441/PL)
helium-3 and -4 elastic scattering at 65.3 Mev, angular distributions from, (E), 20: 19916
nuclear charge distribution in, (E), 20: 19936
proton reactions (p,d) at 55 Mev, angular distributions and spectroscopic factors from, (E), 20: 19877
CALCIUM ISOTOPES Ca-44
nuclear charge distribution in, (E), 20: 19936
CALCIUM ISOTOPES Ca-45
beta decay of, log ft values for, (T), 20: 19932
uptake by bones, effects of cortisone, 20: 18480
CALCIUM ISOTOPES Ca-47
beta decay of, log ft values for, (T), 20: 19932
plasma and renal clearance in man, 20: 18226
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
CALCIUM ISOTOPES Ca-48
beta decay, (E), 20: 20365
beta decay of, detection of double, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
neutron reactions (n,2n) with, effective cross sections for, 20: 19943
nuclear charge distribution in, (E), 20: 19936
photoabsorption and photodisintegration cross sections, (T), 20: 19969
proton inelastic scattering at 10 Mev, angular distributions from, (E), 20: 19929
CALCIUM NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
CALCIUM OXIDES
radiation effects on surface-area and -energy of, irradiated during calcination, x, 20: 19271
radiation effects on oxygen chemisorption by, fast-neutron and gamma, 20: 18787
CaO–HfO_2, crystal structure and stability, 20: 18645
CALCIUM SILICATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
CALCIUM STRONTIUM TITANATES
superconductivity in, (E), 20: 19767
CALCIUM SULFATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
use of kryptonated, for determining water in organic liquids, 20: 18570(R) (NYO-2757-5)
$BaSO_4$–$CaSO_4$, sorptive properties for strontium, 20: 18835
CALCIUM SULFIDES
properties of rare earth doped, electric and optical, 20: 20122
CALCIUM URANATES
crystal structure of Ca_3UO_6, 20: 19223
CALDER HALL REACTORS
design of Dungeness B, 20: 20280
economic and technical appraisal of Dungeness B, 20: 20279
neutron multiplication factor in, optimization of, 20: 20217
CALIFORNIA
radium hazards in, from surplus military commodities, 20: 18984
simulated extraterrestrial environments in, Gulliver III tests on, 20: 18187(R) (N-65-16497)
strontium-90 content in milk, 1960 to 1963, 20: 18968
CALIFORNIA. UNIV., BERKELEY. RADIATION LAB.
environs monitoring, July through Dec., 1964, 20: 18972
CALIFORNIUM ISOTOPES Cf-252
decay of, x-ray emission from, 20: 20365
fission of, electron and x-ray spectra from, 20: 18556(R) (BNL-929, pp 66-82)
fission of, on-line separation of xenon isotopes from spontaneous, 20: 19888
fission of, silicon detectors for measurement of fragment energy from spontaneous, 20: 19070
CALORIMETERS
design for determining absorbed radiation doses, 20: 18198
development, 20: 20177(R) (BNL-929, pp 83-105)
response of conduction, for radiation detection, 20: 19055
CALUTRONS
design and operation of 24-in., with several magnetic field configurations, 20: 19161
performance of ORNL, in-process controls for, 20: 19154
performance of, techniques and feed materials for improvements in, 20: 19152
use for separation and processing of α-γ emitting materials, 20: 19165
CAMBRIDGE SYNCHROTRON
magnet power supplies for, flat topping of, 20: 19303 (PPAD-581D)
shielding calculations for, 20: 19305 (TID-22772)
CANADIAN SHIELD
lead isotopic composition in, geochemical significance of, 20: 18894 (NYO-3450-1, pp 169-84)
CANDU REACTOR
fuel rod boosters for, reactivity effects of, 20: 20225 (AECL-2525)
CAPE KENNEDY AREA (FLORIDA)
dispersion and movement in coastal and inshore waters in, physical processes of, 20: 20359 (NYO-2973-1)
CAPRYLIC ACID, SODIUM SALTS
oxidation in rat liver mitochondria, effects of water-d_2 on, 20: 18217
CAPRYLIC ACIDS, THIO-
radiation effects on content of, in rat adrenals, 20: 18402
CAPTURE-TO-FISSION RATIOS
measurement in low fluxes, method of, 20: 19018(R) (ANL-7110, pp 231-310)
CARBAMIC ACID, DITHIO-
effects on toxicity of mechlorethamine in dogs, 20: 18242
CARBAMIC ACID, ETHYL ESTER
effects on newborn mice, effects of syngeneic bone marrow injections on leukemogenic, 20: 18191
effects on newborn mice, effects of thymectomy and subsequent thymus implantation on leukemogenic, 20: 18192
radiosensitivity effects in mice, 20: 18467
radiosensitivity effects on tumors, 20: 18537
CARBON
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
diffusion in Croloy 9M/type 316 stainless steel composite tubing, 20: 19189 (N-65-21161)
effects of content of, on fast-neutron-induced dimensional changes in graphite, 20: 19252 (BNWL-201)
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
electron transitions of isotopic diatomic molecules of, Franck-Condon factors for, 20: 18658

ion reactions at 0.1 to 0.9 Mev with, stopping cross section for $6 \leq Z \leq 20$, 20: 19368
ionization equilibria in sun, (T), 20: 19338
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron elastic scattering at 95 to 350 Mev, differential cross sections from second-order scattering theory, 20: 19933
performance of resistors of, for temperature measurements at 3 to 80°K, 20: 19721 (CLM-R-47)
proton elastic scattering at 95 to 300 Mev, cross sections and polarization from second-order scattering theory, 20: 19933
reactions with deuterium, hydrogen, and nitrogen at 4.2°K, 20: 18667
reactions with oxides and boric oxide to prepare borides, 20: 18702
spectra of, isotope effects on vibrational transition probabilities in, 20: 18639
x-ray emission spectra from solar isothermal quiet-corona model for line intensities in soft, 20: 19338

CARBON (ACTIVATED)
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
sorptive properties for xenon-131, collector design for measuring, 20: 18994 (SGAE-PH-31/1965)

CARBON BLACK
radiation effects on graphitized, temperature dependence of ESR from neutron, (E), 20: 20144

CARBON DIOXIDES
determination of carbon-14-labeled, using scintillation detectors, 20: 18999
effects on plant growth, 20: 18211(R) (UCLA-12-576, pp 88-111)
electron beam reactions at 40 to 580 ev, effective ionization cross sections from, (E), 20: 19404
electron spin resonance spectrum of radical of, potassium and sodium neighboring ion effects on, 20: 20161
metabolism in algae, effects of pH on, 20: 18206(R) (N-65-16815)
performance in lasers, Fermi resonance and isotope shift effects on, (E), 20: 19937
radiation effects on sorption of, by aluminum oxide at 20 to 350°C, 20: 19264
radiation effects on evolution of, from sulfonic acid ion exchange resins, 20: 18728 (NIJS-R-458)
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
reactions with uranium carbides at high temperatures, 20: 18824(R) (EURAEC-1536)
solubility in cave waters, 20: 18631 (NYO-2266-1)
sorption of carbon-14-labeled, method for measuring, 20: 18999

CARBON ISOTOPES C-11
decay curve for mixture of fluorine-18 and, resolution of, 20: 19074
energy levels of, (E), 20: 19273(R) (BNL-929, pp 3-43)
reactions with alkanes, labeled compound yields from recoil, 20: 18556(R) (BNL-929, pp 66-82)
reactions with cyclopentadiene, mechanisms and yields in, 20: 18715
reactions with deuterated alkyl halides and propane, yields of acetylene from recoil, 20: 18714
reactions with hydrogen in ethylene, production of methyne in, 20: 18716
use in medicine of cyclotron-produced, 20: 18515

CARBON ISOTOPES C-12
alpha emission, parities at 9 to 16 Mev for, (E), 20: 19273(R) (BNL-929, pp 3-43)
carbon-12 reactions (C-12,α) with, 8^+ level from, (E), 20: 19913
deuteron reactions (d,α) at 6.2 to 6.9 Mev, mechanism of, (E), 20: 19972
effects on Franck-Condon factors for electron transitions in carbon molecules, 20: 18658
electron scattering by, dispersion corrections for, (T), 20: 19825 (LAL-1153)
meson (π^+) inelastic scattering at 3 Bev, cross sections for, (T), 20: 19823 (JINR-P-2431)
neutron inelastic scattering at 14.1 Mev, gamma emission in, (E), 20: 19817 (INR-661/IA/PL)
production in boron-11 (α,t) reaction, amplitudes for, (T), 20: 19967
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
proton elastic scattering over 5.3- and 6.6-Mev anomalies, complex phase shifts for, (T), 20: 19922
proton inelastic scattering at 7.85 Mev, cross sections for, (T), 20: 19823 (JINR-P-2431)
proton reactions (p,pα) at 660 Mev, cross sections for, (E), 20: 19977
reactions with lead-208 at 45.5 to 60.2 Mev, octupole Coulomb excitation in, (E), 20: 19894

CARBON ISOTOPES C-13
alpha reactions (α,n) at 12.8 to 22.5 Mev, mechanism of direct, (T), 20: 19947
deuteron reactions (d,α) at 6.2 to 6.9 Mev, mechanism of, (E), 20: 19972
effects on Franck-Condon factors for electron transitions in carbon molecules, 20: 18658
effects on ionization of triphenylmethylchloride, 20: 18556(R) (BNL-929, pp 66-82)
helium-3 reactions (He-3,γ) at 1.0 to 3.5 Mev, differential cross sections and ground-state gamma yields from, (E), 20: 19908
preparation of radiation targets of, 20: 19946

CARBON ISOTOPES C-14
age estimation using, efficiency of methanol and methyl borate for liquid scintillation counting in, 20: 18935
content in atmosphere during last six millennia, fluctuation of, (E), 20: 19683
content in atmosphere, geomagnetic field effects on, (E), 20: 19684
content in atmosphere during 1965, effects of nuclear explosions on, 20: 18917
detection and measurement on bidimensional chromatograms, radiodensitometer for, 20: 19048
determination by scintillation counting using balanced quenching method, 20: 18594
determination in methyl group of organic compounds, 20: 18600
incorporation in alpha- and delta-*N*-methyl-ornithine, 20: 18817
incorporation in benzene, 20: 18710
incorporation in chloroform and methylene chloride, 20: 18708
incorporation in dibenzochrysene, method for, 20: 18801 (CEA-R-2858)
incorporation in glutamic acid, 20: 18721
incorporation in pegene-9-desoxyvasicine, 20: 18723
incorporation in RNA of amino acid-incorporated, biological effects of, 20: 18249
incorporation in terphenyls, methods for, 20: 18803 (EUR-2527.d)
incorporation in 1-(*p*-hydroxyphenyl)-2-aminoethanol, 20: 18709
photoabsorption and photodisintegration cross sections, (T), 20: 19969
radiation effects on uptake of orotic acid-incorporated, by rat liver RNA, x, 20: 18263
separation from sea water, 20: 18934
uses for age determinations in Pacific Islands, 20: 18937

CARBON ISOTOPES C-16
production by proton reactions with target masses $20 \leq A \leq 240$, cross sections for, 20: 18556(R) (BNL-929, pp 66-82)

CARBON MONOXIDES
radiation effects on evolution of, from sulfonic acid ion exchange resins, 20: 18728 (NIJS-R-458)
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
spectra of, isotope effects on vibrational transition probability in, 20: 18639
thermal conductivity of liquid, 20: 19614 (N-65-17283)
CO–ethylene, radioinduced polymerization of, parameters and products of gamma, 20: 20177(R) (BNL-929, pp 83-105)

CARBON OXIDES
photolysis in olefins, products from, 20: 18556(R) (BNL-929, pp 66-82)
photolysis of sub-, reaction of carbon atoms from, 20: 18667

CARBON STEEL
radiation effects on mechanical properties of SA212B, fast-neutron, 20: 19178(R) (IDO-17154)

CARBON SYSTEMS
C–Hf–Ta, phase studies at 2050°C, 20: 19213 (N-65-21739)
C–Ta, corrosion by molten plutonium, 20: 20239(R) (LA-3482)

CARBON TETRACHLORIDE
effects on ion mobilities in irradiated hexane, 20: 18724 (BNL-10012)
effects on radiolysis of solid deuterated cyclohexane, 20: 18733
radiation effects on ion mobilities in, 20: 18724 (BNL-10012)
radiation effects on resonance charge transfer in polycrystalline, 20: 18751
radiation effects on aromatic hydrocarbons in, spectra of resonance charge transfer in, 20: 18752
benzene–CCl_4, radiolysis yields in, 20: 18730 (UJV-1468)
CCl_4–cyclohexane, radiolysis yields in, 20: 18730 (UJV-1468)
CCl_4–cyclohexene, radiolysis yields in, 20: 18730 (UJV-1468)
CCl_4–1,4-cyclohexadiene, radiolysis yields in, 20: 18730 (UJV-1468)

CARBON TETRAFLUORIDE
radiolysis of, yields from gamma, 20: 18772

CARBONATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
radiosensitivity effects on barley seeds, effects of pH on x, 20: 18435

CARBONATITES
age estimation of, using lead-uranium method, 20: 18924(R) (NYO-1669-11)
lead isotopic composition of, 20: 18924(R) (NYO-1669-11)

CARCINOMAS
effects of plant growth regulators on cells of, 20: 18426
incidence of cervical, in pregnant and sterilized women, 20: 20360(R) (PRNC-73)
radiation effects on cells of cervical, gamma, 20: 18330

radiation effects on DNA and DPN in Ehrlich ascites, tracer study of x, 20: 18270
radioinduced keratinization of, following radium or x-ray therapy, 20: 18255
radiosensitivity of rat, effects of cytotoxic and antimetabolite drugs on, 20: 18377
radiosensitivity of, effects of actinomycin on, 20: 18461
radiosensitivity of transplanted rat mammary, effects of chemical compounds on, 20: 18533
radiosensitivity of lung, effects of actinomycin D and 5-fluorouracil on, 20: 18539
radiotherapy of breast, cervical, esophageal, and nasopharyngeal, 20: 20360(R) (PRNC-73)
radiotherapy of cervical, effects of vaginal cells, 20: 18331
radiotherapy of genital and mammary, effects on hematopoiesis, 20: 18552
radiotherapy of gynecologic, followed by femoral osteoradionecrosis, x, 20: 18407
radiotherapy of mammalian, dosimetry in γ, electron and x, 20: 18545
radiotherapy of thyroid, scintillation detector for, 20: 19084
radiotherapy of thyroid, effects on nasal content of iodine-131, 20: 18512
radiotherapy of verrucous oral, anaplastic transformation after, 20: 18547

CAROTENOIDS
radiosensitivity effects in bacteria, 20: 18361

CASCADE SHOWERS
calculation of intranuclear, computer codes for, 20: 20096 (ORNL-3844)
production in shielding of meson production facility, neutron flux from, (T), 20: 20100 (ORNL-TM-1423)

CATALASES
activation of hepatic, by DNA from irradiated and normal rat liver, 20: 18279
radiation effects on, protective effects of chemicals against, 20: 18449

CATARACTS
radiation effects on cytochrome c in, x, 20: 18261(T)
radioinduced formation of, 20: 18198

CATHEPSIN
radiation effects on activity of human leukocyte, 20: 18244 (NIJS-R-467)

CATHODES
preparation and processing of lanthanum hexaboride-coated rhenium, 20: 19229
thermionic emission from lanthanum hexaboride-coated rhenium, Richardson constants for, 20: 19229

CATS
radiation effects on central nervous system in, x, 20: 18292(R) (N-65-17068)

CATTLE
fission product metabolism in, 20: 18188(R) (ORO-635)
iodine metabolism and performance of dairy, effects of iodine-131 on, 20: 18188(R) (ORO-635)
iodine-131 content in thyroid glands of, 20: 18971
iodine-131 excretion by, effects of sodium chloride on, 20: 18223
radiation effects on, pathological γ and neutron, 20: 18188(R) (ORO-635)
radiation effects, 20: 18198

CAVES
camera stage for, design of remotely controlled, 20: 19018(R) (ANL-7110, pp 231-310)

CAVITY RESONATORS
frequency shifts in plasma-loaded, measurement of small, 20: 20055
use for plasma electron density measurements, 20: 20072

CELLULOSE
radiation effects on, gamma irradiation facility for studying, 20: 18732
radioninduced grafting to butadiene–acrylonitrile, 20: 18796(P)
radioinduced grafting to butadiene–styrene, 20: 18798(P)
radioinduced grafting to styrene–acrylonitrile, 20: 18799(P)

CERAMIC COATINGS
pigments for, use of uranium compounds as, 20: 18974

CERAMIC MATERIALS
analysis for uranium for nuclear materials management, review of methods for, 20: 18619
crystal structure ordering in disorder systems of, study of initial onset of, 20: 20112(R) (NYO-2581-1)

CERIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
determination in rare earth separation products by differential spectrophotometry, 20: 18597
determination of, using triphenylarsine oxide, 20: 18607
effects on viscosity of molten iron, 20: 19239
separation from americium and curium by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
separation from praseodymium by solvent extraction using organic phosphorus compounds, 20: 18850
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-n-hexylphosphine oxide), 20: 18599

CERIUM ALLOYS
Al–Ce, phase diagram and crystal structure of intermetallic compounds in, 20: 19247
Ce–Co–Pu, corrosive effects on tantalum and tantalum–tungsten alloys, 20: 20239(R) (LA-3482)
Ce–Co–Pu, radiation effects on liquid, 20: 20183
Ce–Fe, viscosity of molten, 20: 19239
Ce–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Ce–Ge, preparation and crystal structure of CeGe, 20: 19224
Ce–In, crystal structure of Ce_3In, 20: 19226

CERIUM CHLORIDES
magnetic phases, (T), 20: 20143
preparation and properties of alcoholates of, 20: 18671
solubility in non-aqueous solvents of isopropylate of, 20: 18670

CERIUM COMPLEXES
with amines, thermodynamic properties of nitrate, 20: 18829
with 1,2-diaminocyclohexylenetetraacetic acid, uses in determination of thorium, 20: 18598

CERIUM IONS
hydrolysis of trivalent, mechanisms of, 20: 20177(R) (BNL-929, pp 83-105)
reactions in lanthanum chloride crystals, electric quadrupole-quadrupole, (E), 20: 20154
yields in radiolysis of ferrous solutions containing sulfuric acid in presence of cerium sulfate, 20: 18745

CERIUM ISOTOPES Ce-131
half life, 20: 18556(R) (BNL-929, pp 66-82)

CERIUM ISOTOPES Ce-138
energy levels from praseodymium-138 decay, (E), 20: 19957

CERIUM ISOTOPES Ce-141
distribution in sea water in Swordfish Program, 20: 18576(R) (TID-22660)

CERIUM ISOTOPES Ce-142
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

CERIUM ISOTOPES Ce-143
beta decay of, gamma spectra in, (E), 20: 19963

CERIUM ISOTOPES Ce-144
content in organisms and water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
content in Pacific Ocean sediments near mouth of Columbia River, 20: 18902 (RLO-1725-41)
deposition on platinum anode, effects of hydrogen ion concentration on, 20: 18676
distribution in sea water in Swordfish Program, 20: 18576(R) (TID-22660)
excretion of, from efficacy of EDTA, DTPA, and TTHA for promoting, 20: 18438
separation from sea water, method for, 20: 18576(R) (TID-22660)

CERIUM OXIDES
determination in rare earth separation products by differential spectrophotometry, 20: 18597

CERIUM OXYSELENIDES
preparation of, from cerium dioxide and selenium, 20: 18703

CERIUM SELENIDES
preparation of, evaluation of two methods for, 20: 18703

CERIUM SILICIDES
preparation and crystal structure of, 20: 19224

CERIUM SULFATES
effects on yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745

CERMETS
development of tungsten-base, containing fibered or reacted additives, 20: 19179 (N-65-21643)
fracture initiation and modes of failure of, 20: 19218 (NYO-2394-18)
sample preparation procedures for, ceramographic, 20: 19176 (ANL-6975)

CESIUM
determination in photoemissive cells by gamma spectrometry, 20: 18617
diffusion in graphite, 20: 20177(R) (BNL-929, pp 83-105)
effects on vaporization of uranium carbide–zirconium carbide thermionic cathodes, 20: 19212(R) (N-65-21351)
heat of adsorption by alumina and pyrex, 20: 19422 (N-65-26628)
heat transfer from boiling, 20: 20183
ion exchange properties on zirconyl oxalates, 20: 18840
ion exchange reactions with hydrogen on ferrocyanide molybdate, kinetics of, 20: 18564 (EUR-2748.e)
microwave amplification in plasma of, 20: 20052
separation from rubidium by ion exchange, 20: 18811

separation from strontium by electrodialysis, 20: 18842
separation using surface ionization source, efficiency of, 20: 19148
sorption in thermionic converters, (E/T), 20: 19422 (N-65-26628)
spectra of, pressure effects of argon on absorption, (E), 20: 19385
spectra of, pressure effects of helium on absorption, (E), 20: 19386
uptake by plants, effects of soil chemistry on, 20: 18208(R) (TID-22715)

CESIUM IODIDES
gamma photofractions for well-type scintillation crystals of, 20: 19076

CESIUM IONS
reactions with silicon at 1 to 20 kev, channeling effects and penetration in, 20: 20124
sputtering on copper single crystals at 1 to 10 kev, (E), 20: 19359(R) (N-65-24388)
sputtering on copper crystals, yields from, (T), 20: 19407

CESIUM ISOTOPES
excretion of radioactive, use of Prussian Blue in promoting, 20: 18438
production in nitrogen-14 reactions with cesium-133 at 140 Mev, 20: 19927
separation of, thermal ion source for electromagnetic, 20: 19142

CESIUM ISOTOPES Cs-133
nitrogen-14 reactions at 140 Mev, cesium isotope production in, 20: 19927

CESIUM ISOTOPES Cs-134
determination in mixture with cesium-137, sensitivity of coincidence spectrometry and least squares method for, 20: 18580 (USNRDL-TR-934)
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583

CESIUM ISOTOPES Cs-137
calibration of, for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
content in atmosphere along 80th meridian (west) 1964, 20: 18967
content in atmosphere, soil, and food in U. S., 1963 to 1965, 20: 18980
content in diet in U. S., 1961 through 1964, 20: 18920
content in diet in U. S., 1965, 20: 18973
content in fish sold in U. S., 1965, 20: 18973
content in food, 20: 18976
content in human body, September 1962 to August 1963, 20: 18961
content in man, effects of age and diet on, 20: 18233
content in man, effects of diet on, 20: 18234
content in man, 1956 to 1965 whole-body, 20: 18203(R) (LA-3432, pp 21-55)
content in milk after nuclear accident, 20: 18969
content in precipitation in Colorado, 1962 through 1964, 20: 18919
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
determination in mixture with cesium-134, sensitivity of coincidence spectrometry and least squares method for, 20: 18580 (USNRDL-TR-934)
determination in sea water in Genoa, Italy, radiometric, 20: 18592
distribution in mice, effects of temperature on, 20: 18203(R) (LA-3432, pp 21-55)
dosimetry in thin phantoms, 20: 18977
excretion of, effects of ferric ferrocyanide on, 20: 18203(R) (LA-3432, pp 21-55)
metabolism by man, 20: 18198
metabolism in man, 20: 18820
storage of wastes of, packaging facilities for, 20: 20348 (RL-SA-60)
uptake by milk and soils, 20: 18198

CESIUM NITRATES
$CsNO_3-UO_2(NO_3)_2-H_2O$, thermodynamic properties of compound formation in, at 25°C, 20: 18696

CHARGED PARTICLE BEAMS
current density of, measuring device for, 20: 19318(P)
effects on diploid and haploid Saccharomyces, biological, 20: 18405
effects on yeast, biological, 20: 18190(R) (UCRL-16613)
flux distribution at target areas, device for indicating, 20: 19321(P)
motion in plasma, oscillation excitation in, (T), 20: 20063
properties of dense, rate and type of blow-up of, (T), 20: 19286 (BNL-10049)
scattering of spin-1, by spin-0 targets, (T), 20: 19924
transport magnets using iron yokes, (T), 20: 19293 (CERN-66-7)

CHARGED PARTICLES
acceleration in solar flares, (T), 20: 19325 (N-65-22651)
acceleration of, device for stabilizing accelerating voltage during, 20: 19323(P)
detection of low-energy, instrument development for, 20: 19032(R) (N-65-23928)
detection of magnetically trapped, Mariner C instrumentation for, 20: 19034(R) (N-65-27827)
detection using counter telescopes, 20: 19022 (CALT-68-62)
diffusion of, Boltzmann equation for, 20: 19584
effects of channeling of, on defect distribution in crystals, 20: 20133
energy losses in crystals, studies of anomalous, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
motion in magnetosphere, adiabatic, (T), 20: 19640 (N-65-21332)
motion in time-dependent axially symmetric magnetic fields, (T), 20: 20023
motion in varying electromagnetic fields, nonrelativistic equations for, 20: 19282
precipitation in south auroral zone, correlation with geomagnetic index, (E), 20: 19686
production of pulsed waves of, design of apparatus for, 20: 19319(P)
reactions with atoms, stopping power of M electrons for, (T), 20: 19386
reactions with crystals, structure effects on, (E/T), 20: 20104 (BNL-944)
reactions with nuclei, Massey-Mohr total elastic cross sections for, (E/T), 20: 19872

CHELATES
synthesis of, for promoting strontium elimination in urine, 20: 18209 (TID-22717)

CHEMICAL ANALYSIS
methods used at ORNL, master manual of, 20: 18574 (TID-7015 (Suppl.8))
methods used at ORNL, indexes to master manual of, 20: 18575 (TID-7015(Indexes)(Rev.3))
radiation effects on, 20: 18792

CHEMICAL RADIATION DETECTORS
performance of sodium cocodylate and Tris as, 20: 18503 (AD-611869, pp 169-83)
performance of sulfuric acid solution containing iron as, 20: 18793

CHEMICALS AND REAGENTS
use of particles of labeled inorganic, in medicine, 20: 18529

CHEMISTRY
exchange reactions in, conference on, 20: 18635 (STI-PUB-107)
stable isotope uses in, 20: 19120

CHEMOTHERAPY
use with radiotherapy for tumors, 20: 18464

CHERENKOV DETECTORS
materials for, spectral absorption characteristics of lucite, (E), 20: 19021 (CALT-68-53)
use of carbon dioxide-filled, in detection of high-energy primary cosmic particles, 20: 19028 (N-65-16844)

CHERENKOV RADIATION
emission by charged-particle motion in vector fields, classical treatment of, 20: 19458
emission by electrons, relation to bremsstrahlung radiation, (T), 20: 19455
emission in warm plasma in infinite magnetostatic field, (T), 20: 20051

CHICKENS
lipid metabolism in, effects of enzymes and estrogens on, 20: 18295(R) (UCLA-12-576, pp 27-56)
protein metabolism in, tracer study, 20: 18188(R) (ORO-635)
tracer studies of, review, 20: 18236

CHLORAMBUCIL
effects on polycythemia, 20: 18525

CHLORATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

CHLORINE
content in ratio with bromine and iodine in aerosols, atmosphere, and rainwater in Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
effects on determination of moisture content of soils by neutron method, 20: 19118

CHLORINE FLUORIDES
reactions with plutonium oxide–uranium oxide, factors affecting, 20: 18824(R) (EURAEC-1536)
reactions with stainless steel, 20: 18824(R) (EURAEC-1536)
reactions with uranium monocarbide, 20: 18824(R) (EURAEC-1536)
separation from gas streams, methods for, 20: 18824(R) (EURAEC-1536)

CHLORINE IONS
production of monovalent negative, by electron capture in chlorohydrocarbons, (E), 20: 18557 (ORNL-TM-1409)

CHLORINE ISOTOPES Cl-33
energy levels at 8.2 to 9.2 Mev, from sulfur-34 (p,γ) reactions, (E), 20: 19973

CHLORINE ISOTOPES Cl-35
radiation effects on NQR in sodium chlorates, gamma and x, 20: 20118

CHLORINE ISOTOPES Cl-37
proton reactions (p,n) at 3.0 to 5.5 Mev, angular distributions and gamma yields from, (E), 20: 19891

CHLORINE ISOTOPES Cl-38
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583

CHLOROFORM
labeling with carbon-14, 20: 18708

CHLOROHYDROCARBONS
electron capture by, (E), 20: 18557 (ORNL-TM-1409)
CHLOROPHYLLS
distribution in Pacific Ocean near mouth of Columbia River, 20: 18902 (RLO-1725-41)
CHLOROPLASTS
electric charge of spinach, effects of light on, 20: 18190(R) (UCRL-16613)
radiation effects on, uv, 20: 18365
radioinduced inactivation of Euglena, photoreactivation of uv, 20: 18253
CHOLESTEROL
oxidation in rat liver mitochondria, effects of water-d_2 on, 20: 18217
CHOLINE, ACETYL-
effects on blood pressure of rats, effects of AET and cysteamine on, 20: 18239
CHONDROITIN SULFATES
effects on atherosclerosis development in monkeys, 20: 18295(R) (UCLA-12-576, pp 27-56)
CHROMATES
determination of, using triphenylarsine oxide, 20: 18607
CHROMATOGRAPHY
use for separation of radioactive nuclides, 20: 18601
CHROMIC(III) ACID
spectra of deuterated and normal, ir and neutron, 20: 18660
CHROMIUM
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
energy levels in, lifetime and g_J factors for, (E), 20: 19390
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
reactions with uranium nitride at 800 to 1000°C, 20: 19187 (BMI-1760)
CHROMIUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702
CHROMIUM IONS
radiation effects on, in rubies, 20: 20110 (NASA-TN-D-3379)
CHROMIUM ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)
CHROMIUM ISOTOPES Cr-49
beta decay of, log ft values for, (T), 20: 19932
CHROMIUM ISOTOPES Cr-51
beta decay of, log ft values for, (T), 20: 19932
concentration in potassium chromate by Szilard-Chalmers reactions, 20: 18812
content in Pacific Ocean surface water near mouth of Columbia River, 20: 18902 (RLO-1725-41)
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
energy levels from proton reactions (p,d) with calcium-40 at 55 Mev, neutron-hole, (E), 20: 19877
reactions with potassium chromates at 5 to 450 kev, chemical distribution following, 20: 18781
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
CHROMIUM ISOTOPES Cr-52
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
energy levels from proton reactions (p,γ) with vanadium-51 at 0.6 to 2.7 Mev, isobaric analog, 20: 19928
neutron capture at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
proton reactions (p,d) at 55 Mev, angular distributions and spectroscopic factors from, (E), 20: 19877
CHROMIUM ISOTOPES Cr-53
hyperfine structure, (E), 20: 19390
hyperfine structure of, contribution of core polarization to, 20: 19391
CHROMIUM NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
CHROMIUM OXIDES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
CHROMIUM PHOSPHATES
hydroxy-, uptake of phosphorus-32-labeled, by lymph nodes of rabbits, 20: 18241
CHROMIUM STEEL
Cr–Mn–Ni, mechanical properties of austenitic cast, at 2.5 to 4.5°K, 20: 19232
Cr–Mo, corrosion of Croloy 9M, by mercury at 1074°F, 20: 19189 (N-65-21161)
Cr–Mo, diffusion of carbon from Croloy 9M, to type 316 stainless steel in composite tubing, 20: 19189 (N-65-21161)
CHROMOSOMES
abnormalities in human leukocyte, 20: 18307
DNA content of x, in Drosophila, 20: 18332
mutations in radiation-treated cancer cases, 20: 20360(R) (PRNC-73)
properties of Escherichia and Salmonella, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on, gamma and x, 20: 20360(R) (PRNC-73)
radiation effects on Ehrlich ascites tumor cell, oxygen enhancement ratio for x, 20: 18352
radioinduced aberrations of maize, uv and x, 20: 18334
radioinduced aberrations in Vicia root-meristem, dose-response parameters for x, 20: 18350
radioinduced aberrations in barley, effects of dose on γ and fast-neutron, 20: 18355
radioinduced aberrations in mouse bone marrow, after exposure of distant parts, 20: 18356
radioinduced aberrations in mouse, protective effects of intestinal shielding against x, 20: 18432
radioinduced abnormalities in human, 20: 18307
radiosensitivity effects of ploidy in guinea pig, x, 20: 18260
radiosensitivity of, methods of measuring, 20: 18184(R) (BNL-929, pp 115-25)
radiosensitivity of mouse, 20: 18286 (EUR-2462.1)
CHRONOGRAPHS
design and performance of vernier, improvements in, 20: 19008
CIRCUITS
analysis of magnetic, computer program for, 20: 18996 (WAPD-TM-557)
design for gain stabilization of scintillation counters, 20: 19083
design for scanning and digitizing systems for occasional high-density information, 20: 19010
design of, for concentration measurements, 20: 18573 (RISO-120)
fabrication of high-current switching, 20: 18988(R) (ORNL-929, pp 58-66)
radiation effects on semiconductor integrated microelectronic, 20: 19093(R) (AD-629948)
radiation effects on micro-, neutron, 20: 19100 (N-65-18004)
CIRCULATORY DISEASES
radiodiagnosis of malignant, using inorganic labeled particles, 20: 18529
CITRATES
effects on polarographic reduction of benzophenone in ethanol–water system, 20: 18636(R) (TID-22725)
CIVILIAN DEFENSE
furnishings design for shelters, 20: 18946 (ORNL-TM-1428)
radiological target analysis, procedures for, 20: 18938 (AD-629784)
CLAYS
diffusion coefficients in, effects of soil compaction on rubidium-86 and strontium-89, 20: 18816
fission product sorption by, in United Arab Republic, 20: 20350
CLOSTRIDIUM
radiosensitivity of spores of, γ, 20: 18340
CLOUDS
rise termination of, method of determining, 20: 18988(R) (ORNL-929, pp 58-66)
COAL
analysis for ash content, by beta back-scattering techniques, 20: 18596
COATINGS
radiation effects on optical properties of spacecraft temperature-control, electron, 20: 19259
removal from fuel elements, methods for, 20: 18824(R) (EURAEC-1536)
COAXIAL CABLES
burning after external ignition, 20: 18990 (LA-3451)
COBALT
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
determination in iron by bremsstrahlung activation method, 20: 18613
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
distribution in shallow marine environments, 20: 18895 (NYO-3450-1, pp 217-76)
effects on self-diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
neutron magnetic scattering by, temperature dependence of amplitudes for, 20: 20335
neutron total cross section at 4 to 12 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
polarization of hexagonal, 20: 20109(R) (MIT-3031-3)
reactions of recoil, in cobalt complexes, thermal annealing-decomposition competition in, 20: 18765
separation from rare earths by ion exchange chromatography, 20: 18827
separation of recoil, from ion exchanger, 20: 18764
COBALT ALLOYS
Ce–Co–Pu, corrosive effects on tantalum and tantalum–tungsten alloys,

20: 20239(R) (LA-3482)
Ce–Co–Pu, radiation effects on liquid, 20: 20183
Co–Gd–Y, magnetic properties of intermetallic compounds of, (E/T), 20: 20141
COBALT CHROMATES
ammine complexes of, reactions of recoil cobalt atoms in, thermal annealing decomposition competition in, 20: 18765
COBALT COMPLEXES
ethylenediamine, reactions of recoil cobalt atoms in, thermal annealing-decomposition competition in, 20: 18765
hexammine and trisethylenediamine, Szilard-Chalmers reactions of, on ion exchanger, 20: 18764
COBALT ISOTOPES Co-56
neutron capture at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
COBALT ISOTOPES Co-57
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
decay scheme, (E), 20: 19273(R) (BNL-929, pp 3-43)
COBALT ISOTOPES Co-58
energy levels from iron-56 (t,a) reactions, 20: 20177(R) (BNL-929, pp 83-105)
energy levels of, de-excitation modes of, (E), 20: 19859
radiation effects on retention of, in tris(ethylenediamine)cobalt(III) nitrate in aqueous solutions and solid state, 20: 18725 (IS-T-73)
separation from sea water, method for, 20: 18576(R) (TID-22660)
COBALT ISOTOPES Co-59
alpha reactions and elastic scattering on, optical-model potential for, (E/T), 20: 19815 (INP-440/PL)
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,a) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
use in neutron detection by resonance activation, 20: 19018(R) (ANL-7110, pp 231-310)
COBALT ISOTOPES Co-60
beta emission from, momenta dependence of helicity of, (E/T), 20: 19806 (ANL-7130, pp 313-25)
dosimetry in thin phantoms, 20: 18977
effects of, combined with radium on cervical cancer, 20: 18309
elimination of chloride-incorporated, chelation and isotope exchange methods for, 20: 18216
production in Mol BR-2 reactor, 20: 19139
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
use in intravaginal cancer therapy, 20: 18511
uses for determining transition temperatures of crystal systems, 20: 18677
COBALT NITRATES
ammine complexes of, reactions of recoil cobalt atoms in, thermal annealing-decomposition competition in, 20: 18765
complexes with ethylenediamine, radiation effects on cobalt-58 retention in aqueous solutions and solid state of, 20: 18725 (IS-T-73)
ethylenediamine complexes of, reactions of recoil cobalt atoms in, thermal annealing-decomposition competition in, 20: 18765
COBALT OXIDES
catalytic effects on nitrogen oxide decomposition, 20: 20365
COBALT SULFATES
transition temperature in iron or magnesium sulfates, tracer studies of, 20: 18677
COBALT SYSTEMS
Co–WC, microstructure, 20: 19236
Co–WC, sample preparation for electron microscope examination of, 20: 19236
COENZYMES
pyridine, role in radiation protection, 20: 18274
COILS
effects of length of discharge, on space- and time-resolved electron densities in theta-pinch plasma, (E), 20: 20060
COINCIDENCE CIRCUITS
timing element design for medium-fast, univibrator, 20: 19009
COINCIDENCE COUNTERS
design of telescope for detection and measurement of cosmic x radiation, 20: 19030 (N-65-17266)
use of counter telescopes in particle detection, 20: 19022 (CALT-68-62)
COINCIDENCE MEASUREMENTS
effects of accelerator pulsed beams on, 20: 19310
COLCHICINE
derivatives, radiosensitivity effects in mice, 20: 18467
radiosensitivity effects on tumors, 20: 18537
COLLAGEN
properties of, effects of hydroxylysine on, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on properties of macromolecules of, uv, 20: 18252
COLLIMATORS
design and performance for multiple-field measurement of thyroid uptake, 20: 19052
design and testing for scintillation studies of human liver, 20: 19051
COLLOIDS
radiation effects on silica, x-ray scattering studies on fast-neutron, 20: 19254 (CONF-650629-3)
radioactive, sorption of, effects of pH on, 20: 18847
uptake by lymph nodes, effects of pretreatment with Freund adjuvant on, 20: 18241
COLORADO
age estimation of igneous rocks in, 20: 18924(R) (NYO-1669-11)
fallout monitoring, 1962 through 1964, 20: 18919
COLUMBIA RIVER
distribution of water from, in Northeast Pacific Ocean, 20: 18902 (RLO-1725-41)
radioisotope content and transport in, 20: 18902 (RLO-1725-41)
COMPUTER PROGRAMS
ASSAULT, for reactor depletion, FORTRAN II for IBM 7090, 20: 20207 (ORNL-TM-1302)
AZZOR, for kinetics analysis of two-zone fast reactors, 20: 20211 (ZfK-TPh-17)
CATMAN, for neutron spectrometer data corrections, 20: 19047 (UCRL-16595)
CEVITQ, for complex zeros of arbitrary functions, FORTRAN, 20: 19997 (CLM-R-48)
DEMON, program generator for problems involving ordinary differential equations, 20: 19168 (AAEC/E-142)
development for bubble chamber data pattern recognition, 20: 19045 (UCRL-16509)
DIAN, for programming digital computer in analog components, FORTRAN, 20: 20357 (IS-1225)
DTF-II, for solution of one-dimensional multigroup neutron transport equation, FORTRAN II for IBM 7090/7094, 20: 19783 (NAA-SR-10951)
ES, for neutron scattering by reactor moderators, FORTRAN for IBM 7090, 20: 19780 (JAERI-1094)
FIFI 3, for process plant dynamics, FORTRAN IV for KDF 9, 20: 20287 (AEEW-R-453)
FOG, for quality control of flying spot digitizer data, 20: 19044 (UCRL-16508)
FOILNORM, for processing of foil activity data, FORTRAN for CDC3600, 20: 19018(R) (ANL-7110, pp 231-310)
for alloy-fuel calculations in fluid-bed fluoride volatility processes, 20: 18820 (ANL-6992)
for analysis of neutron scattering resonances, 20: 20201(R) (ANL-7110, pp 311-401)
for calculation of reactivity of fast reactors, 20: 20229(R) (ANL-7110, pp 99-229)
for calculation of proton stopping power, 20: 19031(R) (N-65-19766)
for calculation of dead time of counting systems, 20: 19018(R) (ANL-7110, pp 231-310)
for calculation of particle energy losses and scintillation response of phosphors, 20: 19022 (CALT-68-62)
for criticality of gas-cooled heavy-water power reactors, 20: 20267 (UJV-1046)
for criticality of gas-cooled heavy water-power reactors, 20: 20268 (UJV-1422)
for determining normal iodine-131 uptake by thyroid, FORTRAN, 20: 18514
for evaluation of radiation injuries in animals, FORTRAN IV, 20: 18509(R) (UCLA-12-576, pp 61-80)
for fast reactors, 20: 20229(R) (ANL-7110, pp 99-229)
for glass composition for fixation of highly radioactive wastes, FORTRAN II, 20: 20346 (ORNL-3824)
for intranuclear cascade calculations, 20: 20096 (ORNL-3844)
for longitudinal laminar flow in tube bundles, FORTRAN, 20: 18865 (LA-3418)
for Monte Carlo calculations of thermal neutron fluxes, 20: 19786 (WAPD-T-1835(Rev.))
for neutron time-of-flight transmission spectra shape analysis, FORTRAN for IBM 7090, 20: 19833 (RT/FI-(65)48)
for optical model distorted wave functions and phase shifts, 20: 19947
for radio emission from atomic explosions, 20: 18927 (RM-4942(RAND))
for reactor fuel temperature distributions, FORTRAN for IBM 7094, 20: 20190
GAM-TNS, for thermal neutron spectra and group cross sections, 20: 19844 (WANL-TME-1228)
GAPS, for reactivity data analysis for HTGR, FORTRAN IV for IBM 7044, 20: 20238(R) (GA-6829)
GRAFA, for neutron spectra in reactors, FORTRAN IV for IBM 7044,

20: 20205 (JAERI-1097)
HARBOR, for BWR reactivity calculations, for IBM 7094, 20: 20208 (RT/FI-(65)51)
MAC, for fluid flow properties, 20: 18866 (LA-3425)
MACH 1, for one-dimensional neutron diffusion calculations, 20: 20201(R) (ANL-7110, pp 311-401)
MC², for calculation of multigroup neutron cross sections, 20: 20201(R) (ANL-7110, pp 311-401)
MODEL, for calculation of density of atmosphere, 20: 19646 (SC-DC-65-1701)
MO565, for rectangular magnetic network analysis, for Philco 2000, 20: 18996 (WAPD-TM-557)
MUDE, for solution of one-dimensional multigroup neutron diffusion equation, FORTRAN II for IBM 7090-7094, 20: 19777 (CEA-R-2923)
OGRE, subroutines for gamma transport studies, 20: 20095 (ORNL-3805)
OVALT, for thermal loading effects on cylindrical shells, FORTRAN, 20: 18852 (SCL-DR-65-144)
PPA, for photo-peak analysis, FORTRAN, 20: 19014 (AD-616703)
PRIDCO, for one-dimensional multigroup neutron diffusion, 20: 20211 (ZfK-TPh-17)
PROCOPE, for neutron collision probabilities in lattices of cylindrical rods, FORTRAN for IBM 7090, 20: 20203 (EUR-2751.e)
PROZZOR, for criticality calculations for two-zone fast reactors, 20: 20211 (ZfK-TPh-17)
RSKF, for reactor kinetics, FORTRAN for IBM 7030, 20: 20202 (AWRE-0-4/66)
SALAMANDER, for reactor fuel cycle calculations, FORTRAN II for IBM 7090, 20: 20226 (AEEW-R-260)
TRIST, a trilevel multiprogramming executive, for IBM 7094, 20: 19173 (UCRL-16481)
UCOST, for calculating cost of enriched uranium, FORTRAN for IBM 7090, 20: 18822 (BNWL-139)
use in medical research at BNL, 20: 18185(R) (BNL-929, pp 126-47)

COMPUTERS
design of analog, for ESR spectra integration, 20: 19039 (RISO-M-233)
design of digital, for accelerator beam measurements, 20: 19292 (CERN-66-5)
development and performance in physics data analysis, 20: 19273(R) (BNL-929, pp 3-43)
development for nuclear research, 20: 20365
performance of on-line, for data simulation, 20: 19273(R) (BNL-929, pp 3-43)
performance of, for multiple-spectrometer control, 20: 18988(R) (BNL-929, pp 58-66)
programming and use at BNL, 20: 19169(R) (BNL-929, pp 106-11)
programming of digital in analog components, program for, 20: 20357 (IS-1225)
programming of, program for trilevel multi-, 20: 19173 (UCRL-16481)
research, 20: 19171(R) (COO-614-43)
use for combinatorial problems, techniques for, 20: 19839 (UCRL-16478)
use in multiparameter analysis, 20: 18988(R) (ORNL-929, pp 56-66)
use of PDP-5, in data processing and recording systems, 20: 19840 (UCRL-16723)
use on-line with Van de Graaff accelerator and detectors, 20: 19018(R) (ANL-7110, pp 231-310)

CONCRETES
gamma attenuation factors for, (E), 20: 20094 (NP-15926)
moisture content of, atomic effects on thermal neutron scattering determination of, 20: 18610

CONFERENCES
see also introduction to Report Number Index
Low Temperature Physics, IXth International Conference, Part A, Columbus, Ohio, Aug.–Sept. 1964, 20: 19774
Low Temperature Physics, IXth International Conference, Part B, Columbus, Ohio, Aug.–Sept. 1964, 20: 19775
Nuclear Materials Management, Fourth Annual Meeting of Institute of, Buffalo, New York, June 17 to 19, 1963, 20: 20366
Nuclear Physics, International Congress of, Vol. I, Paris, July 1964, 20: 19980
research reactors, utilization of, Vol. I, Athens, Sept. 1963, 20: 20314 (STI/DOC-56(Vol.1))
research reactors, utilization of, Vol. 2, Athens, Sept. 1963, 20: 20315 (STI/DOC-56(Vol.2))

CONNECTICUT
geologic studies on intrusion and metamorphism in rocks in western, 20: 18924(R) (NYO-1669-11)

CONVERSION ELECTRONS
detection and measurement using lithium-drifted surface-barrier silicon detectors, 20: 19079
emission from monocrystalline tantalum containing xenon-133, 20: 20129

COPPER
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
copper-ion reactions at 5 to 20 kev, range-energy relation for, (T), 20: 20134
determination in quartz crystals from Providencia area, Zacatecas, Mexico, activation, 20: 18631 (NYO-2266-1)
determination in sea water, activation, 20: 18576(R) (TID-22660)
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
energy level transitions in sputtering yields of atomic, 20: 19373
fabrication of cylinders of, using magnetic fields, 20: 19199 (RT/EL-(65)9)
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
mesons (π^-) reactions (π^-,n) with, neutron energy spectra from, (T), 20: 19903
neutron elastic scattering by, potentials from second-order multiple scattering theory, 20: 19933
neutron elastic scattering at 84 to 350 Mev, differential cross sections and polarization from second-order multiple scattering theory, 20: 19933
neutron inelastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
preparation of kryptonated, by ion bombardment, 20: 18570(R) (NYO-2757-5)
proton channeling reactions at 2.5 Mev in, radiation damage and temperature effects on, 20: 20132
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
radiation effects on strength of, neutron, 20: 20365
separation from rare earths by ion exchange chromatography, 20: 18827
sputtering by argon ions at 20 kev, transparency model for, (E), 20: 19371
sputtering by argon, cesium, and copper ions, yields from, (T), 20: 19407
sputtering of monocrystalline, by copper ions at 1 to 15 kev, (T), 20: 19370
sputtering of single crystals of, by cesium ions at 1 to 10 kev, (E), 20: 19359(R) (N-65-24388)
tellurium-125 Mössbauer effect in, (E), 20: 20148
xenon-133 injection into monocrystalline, thermal release following, 20: 20145

COPPER ALLOYS
Be–Cu, lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363

COPPER CHLORIDES
positron annihilation in, origin of second lifetime component from, (E), 20: 19486
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

COPPER FORMATES
magnetic properties of, determination of, by neutron diffraction, 20: 20360(R) (PRNC-73)

COPPER IONS
radiation effects on content of, in rat liver DNA, 20: 18279
sputtering on copper crystals, yields from, (T), 20: 19407
sputtering on monocrystalline copper at 1 to 15 kev, (T), 20: 19370

COPPER ISOTOPES Cu-57
beta decay of, (T), 20: 19914

COPPER ISOTOPES Cu-58
energy levels from nickel-58 (p,n) reactions, 202-kev, (E), 20: 19914

COPPER ISOTOPES Cu-63
energy level transitions in, probabilities of E2 and M1, (T), 20: 19976
energy levels of, from unified model, 20: 19892
neutron absorption resonance integrals, 20: 20201(R) (ANL-7110, pp 311-401)
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,α) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
proton reactions (p,xn) at 1 Bev, recoil angular distributions from, 20: 18556(R) (BNL-929, pp 66-82)

COPPER ISOTOPES Cu-64
separation from manganese-54 and zinc-65 in sea water, method for, 20: 18576(R) (TID-22660)
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
separation from sea water, method for, 20: 18576(R) (TID-22660)

COPPER ISOTOPES Cu-65
neutron absorption resonance integrals, 20: 20201(R) (ANL-7110, pp 311-401)
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810

(EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
proton reactions (p,pn) at 1 Bev, recoil angular distributions from, 20: 18556(R) (BNL-929, pp 66-82)
proton reactions (p,pπ+) at 1 Bev, recoil angular distributions from, 20: 18556(R) (BNL-929, pp 66-82)

COPPER NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)

COPPER SULFIDES
Cu_2S–Dy_2S_3, phase studies, 20: 18644
Cu_2S–Er_2S_3, phase studies, 20: 18644
Cu_2S–Ho_2S_3, phase studies, 20: 18644
Cu_2S–Lu_2S_3, phase studies, 20: 18644
Cu_2S–Tb_2S_3, phase studies, 20: 18644
Cu_2S–Tm_2S_3, phase studies, 20: 18644
Cu_2S–Yb_2S_3, phase studies, 20: 18644
Cu_2S–Y_2S_3, phase studies, 20: 18644

CORDILLERAN FORELAND REGION
hydrothermal and plutonic activity in, 20: 18924(R) (NYO-1669-11)

CORROSION
measurement by beta backscattering and x-ray induction methods, 20: 19196

CORROSION LOOPS
corrosion product separation in mercury, 20: 19189 (N-65-21161)
operation of anisole–boron trifluoride, for ANCO Process, 20: 19135(R) (K-C-718)

CORTICOSTEROIDS
effects on perithyroid edema, 20: 18358
radiation effects on content of, in rat adrenals, 20: 18402

CORTISONE
effects on uptake of calcium-45 by bones, 20: 18480
radiosensitivity effects on tumors, 20: 18480

COSMIC ELECTRONS
production mechanisms for, lightning and solar-flare, 20: 19412

COSMIC MESONS (π)
production and decay of, in high-energy jets, 20: 19411

COSMIC NEUTRINOS
detection of, review of, 20: 19409 (ANL-7130, pp 393-405)
detection underground, system for, 20: 19408 (ANL-7130, pp 373-92)

COSMIC PARTICLES
detection of high-energy primary, using carbon dioxide-filled Cherenkov detectors, 20: 19028 (N-65-16844)
interactions at high altitude, use of emulsion cloud chamber for detection of, 20: 19411
origin of, gravitational effect in, 20: 19410

COSMIC PHOTONS
energy spectra and transverse momentum of, from cascade jets, 20: 19411

COSMIC PROTONS
interactions with protons, cross section for quark production in, (T), 20: 19494

COSMIC RADIATION
absorption in auroral zone, mechanism for noise, (E), 20: 19681
detection and measurement in space, ionization chambers and Geiger-Mueller tubes for, 20: 19029 (N-65-16933)
detection and measurement of x, counter telescope for, 20: 19030 (N-65-17266)
dosimetry of, plant materials for, 20: 18964
effect on ionization of nocturnal ionospheric D region, 20: 19662
effects on cancerous human cells, 20: 18363
effects on phage production in *E. coli*, 20: 18363
intensity of primary, long term modulation of, (T), 20: 19413
intensity variations of, measurement of spatial, 20: 18556(R) (BNL-929, pp 66-82)
origin of, gravitational effect in, 20: 19410
properties of, review of, 20: 19645 (NASA-SP-97)

COSMIC SHOWERS
detection and measurement of high-energy jet, emulsion cloud chamber for, 20: 19411

COSMOLOGY
model for oscillating universe with time symmetry in, 20: 19342
model of oscillating isotropic universe, without singularity, 20: 19344
model of universe, Einstein vacuum field equations for, 20: 19716
models in, Einstein field equations in spatially homogeneous relativistic dust, 20: 19708
models of universe, quasi-stellar-galaxy and quasi-stellar-radiosource effects on, 20: 19354

COTTON
radiation effects on lipid metabolism in seedlings of, γ, 20: 18374
radiation effects on, mutagenic, 20: 18409

COUNTING DEVICES
counting errors and dead time, 20: 19018(R) (ANL-7110, pp 231-310)
development of particle, for hematological studies, 20: 18186(R) (LA-3432, pp 102-29)

***m*-CRESOL**
production in decomposition of anisole by heat, 20: 19135(R) (K-C-718)

***o*-CRESOL**
production in decomposition of anisole by heat, 20: 19135(R) (K-C-718)

***p*-CRESOL**
production in decomposition of anisole by heat, 20: 19135(R) (K-C-718)

CRITICAL ASSEMBLIES
design of portable water-cooled water-reflected neutron source, 20: 19782 (LA-3374)
gamma heating in AARR, measurement using thermoluminescent dosimetry, 20: 20200(R) (ANL-7110, pp 29-98)
physics calculations for enriched urania-fueled, (E/T), 20: 20177(R) (BNL-929, pp 83-105)

CRITICALITY STUDIES
for Argonne Advanced Research Reactor, 20: 20200(R) (ANL-7110, pp 29-98)
of graphite–uranium-235 assemblies, 20: 20183
of plutonia–urania fuel elements, 20: 20183
on clustered and uniform arrays of rodded absorbers, 20: 20210 (WCAP-3269-39)

CROSS SECTIONS
calculation of total elastic, Massey-Mohr method for, (E/T), 20: 19872

CRUSTACEA
plutonium-239 uptake by lobster, 20: 18227
radiopreservation of Pacific coast, gamma, 20: 19126
radiosensitivity of artemia eggs, effects of moisture content and temperature on gamma, 20: 18342
radiosensitivity of oocytes of *Artemia salina*, x, 20: 18447

CRYOGENICS
conference, 20: 19774
conference, 20: 19775
cooling system design using helium, 20: 18877

CRYOSTATS
design and fabrication of, for superconducting coils, 20: 19731
design for neutron diffraction studies, 20: 19769

CRYSTALLOGRAPHY
lattice unit cell dimension measurement using x-ray diffraction, 20: 20168

CRYSTALS
charged particle reactions with, structure effects on, (E/T), 20: 20104 (BNL-944)
charged-particle energy losses in, studies of anomalous, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
color centers in dielectric, specular reflection variations from, (E), 20: 20105(R) (COO-587-19)
defect interactions in, thermodynamics and internal friction studies on, 20: 20113(R) (NYO-3001-1)
elastic anharmonic properties of perfect, 20: 20112(R) (NYO-2581-1)
electron band structure of one-dimensional, Hill's equation for, 20: 20120
ion reactions with, studies on, 20: 20121
lattice dynamics of, analysis using inelastic scattering of thermal neutrons, 20: 20170
lattice vibrations in, dynamics of, (T), 20: 20108 (LA-3471)
neutron diffraction, (T), 20: 19795
neutron magnetic scattering by molecular, elastic and inelastic, 20: 20165
properties of, containing high concentrations of point defects, 20: 20112(R) (NYO-2581-1)
quantum theory for, Green function estimation of Schroedinger operator in, 20: 19702
radiation effects on organic, 20: 20360(R) (PRNC-73)
radiation effects on ionic, 20: 20365
radioinduced defects by charged-particle channeling in, 20: 20133
radioinduced thermoluminescence in molecular, 20: 18759
sputtering by heavy ions at low energies, research progress on, 20: 19358(R) (N-65-17255)
x-ray photoelectric absorption in, (T), 20: 20147

CULTURE MEDIA
research on microbial, 20: 18187(R) (N-65-16497)

CUMENE
radioinduced oxidation of liquid, effects of sodium hydroxide on rate of, 20: 18727 (JAERI-1100)
reactions of, on gamma-irradiated alumina–silica, effects of annealing, hydrogen, and oxygen on, 20: 18768

CURIUM
preparation of thick and thin sources of, by electroplating and electrophoresis, 20: 18562(R) (EUR-2640.e)
separation from americium by ion exchange, 20: 18848
separation from americium and rare earths by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)

separation from americium and rare earths by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
CURIUM IONS
solvent distribution in nitric acid solutions with dodecylamine and trioctylphosphine oxide in diethylbenzene, effects of lithium nitrate on, 20: 18561 (EUR-2635.d)
CURIUM ISOTOPES Cm-242
half life, (E), 20: 19805(R) (ANL-7110, pp 1-28)
CURIUM ISOTOPES Cm-244
half life, (E), 20: 19805(R) (ANL-7110, pp 1-28)
CYANOGEN
spectra of, isotope effects on vibrational transition probability in, 20: 18639
CYCLOBUTANE
thermal decomposition of, effects of deuterium on, 20: 18713
1,3-CYCLOHEXADIENE
yields from reactions of recoil tritium with benzene, 20: 18814
1,4-CYCLOHEXADIENE
yields from reactions of recoil tritium with benzene, 20: 18814
CCl_4–1,4-cyclohexadiene, radiolysis yields in, 20: 18730 (UJV-1468)
CYCLOHEXANE
radioinduced thermoluminescence of, at 77°K, role of molecular motions in, 20: 18760
radiolysis of solid deuterated, effects of other hydrocarbons on yields from, 20: 18733
radiolysis of tritium-saturated, yields from internal, 20: 18778
CCl_4–cyclohexane, radiolysis yields in, 20: 18730 (UJV-1468)
CCl_4–cyclohexene, radiolysis yields in, 20: 18730 (UJV-1468)
CYCLOHEXANE, METHYL-
yields from radiolysis of iodomethane in cyclohexene, tracer studies of, 20: 18771
CYCLOHEXANESUCCINIC ACID, SODIUM SALT
effects on rabbit bone marrow, effects of lysozyme on, toxic, 20: 18470
pharmacology of, 20: 18538
pharmacology of, in experimental animals, 20: 18378
radiosensitivity effects on hamster melanomas, 20: 18463
radiosensitivity effects on bone marrow of guinea pigs and rabbits, 20: 18494
radiosensitivity effects in tumors, 20: 18538
radiosensitivity effects in tumors, 20: 18542
CYCLOHEXANOL
effects on phosphorus-32 uptake by irradiated rats, 20: 18379
radiolysis of, at 77°K, ESR spectra of free radicals from gamma, 20: 18758
CYCLOHEXENE
cyclohexene–iodomethane, radiolysis of, tracer studies of yields from, 20: 18771
CYCLOHEXENE, 1-METHYL-
yields from radiolysis of iodomethane in cyclohexene, tracer studies of, 20: 18771
CYCLOHEXENE, 3-METHYL-
yields from radiolysis of iodomethane in cyclohexene, tracer studies of, 20: 18771
CYCLONE SEPARATORS
performance of radial-vane, for steam–water, 20: 18864 (GEAP-4935)
CYCLOPENTADIENE
reactions with carbon-11, mechanisms and yields in, 20: 18715
with europium, preparation and stability of, 20: 18699
CYCLOPROPANE
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742
CYCLOTRON RADIATION
emission by ultrarelativistic electrons in dipole field, Stokes parameter two-dimensional distributions for, 20: 19456
emission from plasma, dispersion properties of, (E/T), 20: 20000 (IPP-2/43)
CYCLOTRONS
beam extraction from isochronous, ν_z radial resonance in, 20: 19317
design, performance, and uses of sector-focused, 20: 19312
development of fixed-frequency, 20: 19314
radioisotope production in, medical use of, 20: 18515
CYLINDERS
thermal loading of shells of, dynamic response to, (T), 20: 18852 (SCL-DR-65-144)
CYSTEINE
effects on normal tissues and tumor growth, 20: 18475
effects on phosphorus-32 and sulfur-35 uptake by bone, 20: 18479
radiation chemistry of aqueous solutions of, γ, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiosensitivity effects on *Serratia marcescens*, x, 20: 18448
radiosensitivity effects on yeast, 20: 18503 (AD-611869, pp 169-83)
radiosensitivity effects on rat tumors, 20: 18533
CYTOCHROME C
radiation effects on, x, 20: 18261(T)
radioinduced reduction on ferri-, hydroxyl radical effects on gamma, 20: 18773
CYTOLOGY
methods for studies on regeneration of intestinal epithelium, 20: 18291(R) (N-65-16815)
of human blood cultures, 20: 18185(R) (BNL-929, pp 126-47)
of neutron capture by boron-10 in cell mixtures, 20: 20360(R) (PRNC-73)
radiation effects on mouse peritoneal cavity, x, 20: 18285 (AD-630103)
radiation effects on laryngeal tissue, γ, 20: 18311
CYTOPLASM
radiation effects on plant, review of large-dose, 20: 18277
CYTOSINE
fluorescence of aqueous, at room temperature, 20: 20360(R) (PRNC-73)
labeling with tritium, 20: 18719

D

DAREX PROCESS
waste fixation in, computer program for glass composition for, 20: 20346 (ORNL-3824)
DATA RECORDING SYSTEMS
design of semi-automatic, for scanning photographs of oscillographic traces, 20: 18991 (LNF-65/43)
design using PDP-5 computers, 20: 19840 (UCRL-16723)
development for nuclear research, 20: 20365
operation of on-line, for AGS and bubble chamber data, 20: 19273(R) (BNL-929, pp 3-43)
DATA TABULATIONS
atmospheric neutral property variations, solar-activity and local-time dependent upper, 20: 19650
electron synchrotron radiation in dipole field, Stokes parameter two-dimensional distributions for ultrarelativistic, 20: 19456
geomagnetic and solar activity parameters from Jan. to Sept. 1965, 20: 19679
neutron reactions (n,α), (n,2n), (n,np), (n,p), and (n,t) with nuclei below 20 Mev, excitation functions for fast, 20: 19883
nuclear beta decay log ft values and magnetic moments, 20: 19932
nuclear data for A = 182 isotopes, 20: 19879
nuclear data for A = 183 isotopes, 20: 19880
nuclear data for A = 184 isotopes, 20: 19881
nuclear data for A = 185 isotopes, 20: 19882
stellar evolution rates, two-color diagram for, 20: 19347
DECONTAMINATION
book: *Decontamination and Deactivation Instruments*, in German, 20: 18979
compounds for *in vivo*, 20: 18438
methods for area, 20: 20358(R) (JAERI-5014)
methods for milk, 20: 18976
radiation dose during, after nuclear attack, 20: 18938 (AD-629784)
DECONTAMINATION OF EQUIPMENT
methods used in pilot plant for waste processing by calcination, 20: 20345 (BNWL-SA-569)
DEER
hair and subcutaneous tissue analysis by neutron activation, 20: 18618
DEHYDROGENASES
radiation effects on activity of glutamic, in mouse spleen tissue, 20: 18280
radioinduced inactivation of lactate, reaction mechanisms in uv and x, 20: 18451
DENSITOMETERS
development of radiometric, for carbon-14 measurement on bidimensional chromatograms, 20: 19048
DENSITY
radiation effects on deoxyribonucleohistone, 20: 18789
DETONATION WAVES
propagation in refracting atmospheres, yield-scaling factors for, (T), 20: 19618 (SC-RR-65-369)
DEUTERIOORGANIC COMPOUNDS
effects on biological materials, 20: 18214
properties of, chemical and physical, 20: 18214
DEUTERIUM
content in marine atmosphere and sea water, variations in, 20: 18896 (NYO-3450-1, pp 277-374)
crystal structure at 1.0 to 19.4°K, from x-ray studies, 20: 20156
crystal structure of, 20: 20160
distribution in sea water, factors affecting, 20: 18201 (NYO-3450-1, pp 149-68)
effects on biological materials, 20: 18214
effects on critical solution temperatures of phenols in heavy water, 20: 18720
effects on ESR spectra of irradiated ammonium sulfates, 20: 18761
effects on solvolysis of benzenesulfonic acid in water, 20: 18643

effects on thermal decomposition of cyclobutane, 20: 18713
electron temperature in theta-pinch plasma of, effect of impurities on, (E), 20: 20046
incorporated in pyridoxals, 20: 18718
ionization of, Franck-Condon factors for, 20: 18664
neutron elastic scattering at 3.8 and 4.6 Mev, polarization in, (E), 20: 19870
reactions with carbon at 4.2°K, 20: 18667
scattering on rare gases, velocity dependence of total cross section for molecular, (E), 20: 19378
separation from deuterium hydrides and hydrogen by ion exchange, effects of temperature on, 20: 18589
thermal conductivity of liquid, 20: 19614 (N-65-17283)
thermodynamic properties of, quantum mechanics of, (E/T), 20: 18656
transport properties of gaseous, at 10 to 300°K, 20: 18665
yields from radiolysis of solid deuterated cyclohexane, effects of other hydrocarbons on, 20: 18733

DEUTERIUM HYDRIDES
separation from deuterium and hydrogen by ion exchange, effects of temperature on, 20: 18589
transport properties of gaseous, at 10 to 300°K, 20: 18665
yield from radiolysis of solid deuterated cyclohexane, effects of other hydrocarbons on, 20: 18733

DEUTERIUM IONS
reactions with alkanes, spectral studies on, 20: 18657

DEUTERIUM SYSTEMS
D–ethylene, yields in mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)

DEUTERONS
angular distributions and spectroscopic factors from proton reactions (p,d) with calcium-40, chromium-52, and nickel-60 at 55 Mev, (E), 20: 19877
interactions with nucleons, review of, 20: 19982
interactions with mesons (π^-), dynamical theory for final-state, 20: 19273(R) (BNL-929, pp 3-43)
interactions with mesons (π^-), resonances from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with nucleons, asymmetry and multiple scattering in, (T), 20: 19492
interactions with protons at 140 Mev, cross sections for bremsstrahlung production in, (E), 20: 19496
interactions with electrons, neutron form factors from, (E), 20: 19509
interactions with photons, isotopic relations for mesons (K) and (π) production amplitudes from, (T), 20: 19518
production in proton interactions with protons, peripheral model for, 20: 19466
reactions (d,α) with oxygen-16, angular distributions from, (T), 20: 19967
reactions (d,α) with silicon-30 at 6.5 and 6.7 Mev, angular distributions from, (E), 20: 19971
reactions (d,α) with carbon-12 and -13 at 6.2 to 6.9 Mev, mechanism of, (E), 20: 19972
reactions (d,n) with iron-54 and nickel-58 at 7.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
reactions (d,n) with beryllium-9 at 2.6 to 7.0 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
reactions (d,n) with aluminum-27 at 7.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
reactions (d,n) with magnesium-24 and silicon-28 at 7.0 to 10.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
reactions (d,p) with nuclei, amplitudes for, (T), 20: 19974
reactions (d,p) with strontium-88 at 7 Mev, proton spectra from, (T), 20: 19826 (MIT-2098-229)
reactions (d,p) with silicon-28, silicon-29 levels from, (E), 20: 19846
reactions (d,p) with argon-36 at 11 Mev, argon-37 level structure from, (E), 20: 19895
reactions (d,p) with argon-40 at 11 Mev, argon-41 level structure from, (E), 20: 19895
reactions (d,p) with nuclei, sensitivity to truncated potential, (T), 20: 19925
reactions with aluminum and gold at 20 kev, penetration depth distributions from, (E), 20: 20137
reactions with helium-3, products from, (E), 20: 19273(R) (BNL-929, pp 3-43)
reactions with nuclei, neutron single-particle states from, (T), 20: 19849
spectra in heavy ice, NMR, 20: 20365

DIABETES
effects on body potassium content, determination by whole-body counting of potassium-40, 20: 18509(R) (UCLA-12-576, pp 61-80)
effects on cardiovascular and renal functions, tracer evaluations of, 20: 20360(R) (PRNC-73)
tracer studies using labeled carbohydrates, 20: 18185(R) (BNL-929, pp 126-47)

DIAMONDS
production in contrasting gaseous spheres, (T), 20: 19345
x-ray scattering by neutron-irradiated single-crystal, (E/T), 20: 19273(R) (BNL-929, pp 3-43)

DIBENZOCHRYSENE
preparation of carbon-14-labeled, method for, 20: 18801 (CEA-R-2858)

DICHROMATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

DIDO REACTORS
operation and maintenance of Dido and Pluto, problems in, 20: 20323

DIELECTRICS
color centers in, specular reflections variations from, (E), 20: 20105(R) (COO-587-19)

DIET
cesium-137 content in U. S., 1965, 20: 18973
cesium-137 content in, effects on content in man, 20: 18234
effects on cesium-137 content in man, 20: 18233
radioactivity in U. S., 1961 through 1964, 20: 18920
radioactivity in, 1965, 20: 18914
radioactivity in, Jan. to July, 1965, 20: 18972
radiosensitivity effects on yield of temperature-sensitive mutations in Paramecium, x, 20: 18349

DIETHYLAMINE, 2,2'-DICHLORO-N-METHYL-
effects on dogs, effects of diethyl-dithiocarbamate on toxic, 20: 18242

DIETHYLENETRIAMINE
synthesis of, method for, 20: 18209 (TID-22717)

DIFFERENTIAL EQUATIONS
Cauchy problem for coupled Dirac and Maxwell, existence and uniqueness of solutions for, 20: 19703
quantum mechanics linearization of Boltzmann, 20: 19705
solution of ordinary, computer program for, 20: 19168 (AAEC/E-142)
solutions for first order, computer program for, 20: 20287 (AEEW-R-453)
use in analysis of continuous spectra perturbations, 20: 19169(R) (BNL-929, pp 106-11)

DIODES
development of high-temperature ceramic rectifiers and thyratrons, 20: 19416(R) (N-65-17881)
electric conductivity of insulators in cesium-filled thermionic, sorption effects on, (E/T), 20: 19422 (N-65-26628)
electric impedance of plasma filled, (T), 20: 20090
ion oscillations in thermionic, effects on power output, 20: 20201(R) (ANL-7110, pp 311-401)
plasma production in thermionic, methods of, 20: 19415 (N-65-16645)
preparation of radiation-resistant thin-film, 20: 19096(R) (N-65-17884)
radiation effects on IN250, 20: 19103 (N-65-19758)
use of semiconductor, in photomultiplier tubes, 20: 19042 (UCRL-14445)

DIOXANE
radiation effects on ion mobilities in, 20: 18724 (BNL-10012)

DISASTERS
contamination of pastures and milk by cesium-137, strontium-89, and strontium-90 released by, 20: 18969
radioactive contamination of environment by, countermeasures for, 20: 18980

DISEASES
radiation effects on immunity to smallpox in rabbit, x, 20: 18408
radioinduced perithyroid, following radiotherapy of thyroid cancer, gamma, 20: 18358

DISULFIDE, BIS(DIMETHYLTHIOCARBAMOYL)-
use in preventing radiation damage to TBP, 20: 18800(P)

DISULFIDES
β-hydroxyethyl-2,4-dinitrophenyl, reactions with SH-components of glutathione myocin A, and ovalbumin, 20: 18722
effects on biological systems, chemical, 20: 18453
reactions with thiols, 20: 18276
synthesis of cyclic, for testing as radioprotective compounds, 20: 18424

DIURETICS
effects of radioactive mercurial, in rats, 20: 18295(R) (UCLA-12-576, pp 27-56)

DODECANE
dodecane–HNO_3–TBP–$UO_2(NO_3)_2$–H_2O, equilibrium relations for, for nitric acid-uranyl nitrate extraction, 20: 18844

DODECYLAMINE
dodecylamine–HNO_3 trioctylphosphine oxide, distributions coefficients for americium, curium, plutonium, and promethium ions in, 20: 18561 (AMR-2635,d)

DOGS
effects of merchlorethamine on, effects of diethyl-dithiocarbamate on toxic, 20: 18242
phosphorus absorption in intestine of, effects of high-frequency and ultrasonic vibrations on, 20: 18219
radiation effects on gold-198 uptake by lymph nodes in, x, 20: 18306
radiation injuries in, effects of quinoxaline-di-N-oxide on, 20: 18465

radioactivity in respiratory tract of, detection of α and β, 20: 18235
radioinduced gastrointestinal syndrome in, effects of bile on, 20: 18185(R) (BNL-929, pp 126-47)
DOSIMETERS
development, 20: 20177(R) (BNL-929, pp 83-105)
development and testing, 20: 20358(R) (JAERI-5014)
properties of biological, for space flight, 20: 18964
use as auxiliary equipment for research reactors, 20: 20328
use of microorganisms as, 20: 18503 (AD-611869, pp 169-83)
use of semiconductor, for wide-range gammas, 20: 19015 (AD-629511)
use of sintered iron sulfate glass, for bone, 20: 18953
DROSOPHILA
effects of magnetic fields on behavior in, 20: 18410
genetic structure of natural populations of *D. melanogaster*, 20: 18333
radiation effects on genetics in, effects on dose on x, 20: 18324
radiation effects on mitotic delay in testis of, 20: 18354
radiation effects combined with magnetic fields on behavior in, gamma, 20: 18410
radiation effects on spermatogenesis in, x, 20: 18310
radioinduced mutations in, β, γ, and x, 20: 18332
radioinduced mutations of, 20: 18333
radioinduced mutations in sperm of, x, 20: 18336
radioinduced polygenic mutations of, x, 20: 18415
DRUGS
effects of antiemetic, during radiation sickness, 20: 18549
effects on tumor radiosensitivity, 20: 18238
radiosensitivity effects of cytotoxic and antimetabolite, on rat carcinomas, 20: 18377
radiosensitivity effects of, affecting central nervous system in mice, 20: 18459
radiosensitivity effects of psychotropic, in mice, x, 20: 18501
use with radiotherapy for tumors, 20: 18464
DRYING AGENTS
radiosensitivity effects on mutation frequency in tomato pollen, γ, 20: 18393
DUSTS
effects of radioactive, on plant growth, 20: 18211(R) (UCLA-12-576, pp 89-111)
radiation monitoring of, in Japan, 20: 18921
radioactivity in, 1965, 20: 18914
radioactivity in, 1965, 20: 18915
DYES
use of Rhodamine fluorescent, for tracer studies on dispersion and movement of waters of Cape Kennedy, 20: 20359 (NYO-2973-1)
DYSPROSIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
effects on x-ray fluorescent spectrometric determination of yttrium, 20: 18611
separation from other rare earths by partition chromatography using *bis*(2-ethylhexyl) phosphate, 20: 18837
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
DYSPROSIUM ALCOHOLATES
preparation and properties of, 20: 18652
DYSPROSIUM ALLOYS
Dy–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Dy–Ge, preparation and crystal structure of DyGe, 20: 19224
DYSPROSIUM ISOTOPES Dy-151
alpha spectra and half life, (E), 20: 19962
DYSPROSIUM ISOTOPES Dy-152
alpha spectra and half life, (E), 20: 19962
DYSPROSIUM ISOTOPES Dy-153
alpha spectra and half life, (E), 20: 19962
DYSPROSIUM ISOTOPES Dy-154
alpha spectra, (E), 20: 19962
DYSPROSIUM ISOTOPES Dy-160
energy levels of, g-factor and lifetime of, (E), 20: 19846
DYSPROSIUM ISOTOPES Dy-161
nitrogen-14 inelastic scattering by, Coulomb excitation in, (E), 20: 19959
DYSPROSIUM ISOTOPES Dy-164
neutron absorption resonance integrals, 20: 20201(R) (ANL-7110, pp 311-401)
DYSPROSIUM SILICIDES
preparation and crystal structure of, 20: 19224
DYSPROSIUM SULFIDES
Ce_2S–Dy_2S_3, phase studies, 20: 18644

E

EARTH
formation of, lead isotopic variation studies on, 20: 18894 (NYO-3450-1, pp 169-84)
formation of, potassium-40 abundance for mechanism determination for, (E), 20: 19341
magnesium isotope ratio variation in natural samples from, (E), 20: 18908
potassium-40 abundance in, variations in, (E), 20: 19341
thermal stresses below crust of, effects of radioactive inclusions on, 20: 18899
wave interactions in, Feynman diagrams and rules for ocean and seismic, 20: 18936
ECOLOGY
effects on radionuclide content in marine organisms, 20: 18903 (RLO-1750-3)
marine, tracer studies off Puerto Rico, 20: 20360(R) (PRNC-73)
of plants, radiation effects on, 20: 18184(R) (BNL-929, pp 115-25)
of Puerto Rican rain forest, 20: 20360(R) (PRNC-73)
radiation effects on field and forest, 20: 18198
EGGS
radiation effects on development of *Bombyx mori*, γ, 20: 18345
radiation effects on respiration in Bombyx, x, 20: 18301
radiosensitivity of artemia, effects of temperature and water content on, 20: 18342
ELECTRIC ARCS
ion distribution in plasma of vacuum spark, 20: 20025
ELECTRIC CONDENSERS
radiation effects, 20: 19099(R) (N-65-17954)
radiation effects on tantalum, 20: 19103 (N-65-19758)
ELECTRIC CONDUCTIVITY
radioinduced in ionization chambers, 20: 19112
ELECTRIC DISCHARGE
current convection of positive column in low-pressure, in magnetic fields, 20: 19629
electric current and spark-channel radius of spark, time variations of, (T), 20: 19638
pinch effect in linear, production of dense plasma by, (E/T), 20: 20029
ELECTRIC FIELDS
distribution in magnetosphere, model for, 20: 19674
effects of alternating, on harmonic production in weakly ionized argon, (T), 20: 20031
effects on spiraling-mirroring domain of geomagnetically trapped electrons, 20: 19660
effects on turbulent flow of charged fluid in nonconducting channel, (T), 20: 19637
electron transport in, Boltzmann equation for, 20: 19585
ELECTRIC GENERATORS
design and performance of 1-Mw superconducting, 20: 19424 (NASA-TN-D-3345)
plasma production in thermionic, methods of, 20: 19415 (N-65-16645)
ELECTRIC INSULATORS
development for in-pile thermocouples, 20: 20185 (CONF-650204-9)
ELECTRIC POWER
distribution system for AGS, 20: 19285(R) (BNL-929, pp 44-57)
generation by MHD generators using liquid metals, 20: 20201(R) (ANL-7110, pp 311-401)
ELECTRIC PROBES
efficiency of electron emitting or cold electron-collecting, for ion-acoustic wave detection, 20: 19012
performance of electron-emissive, for plasma potential measurements, 20: 20053
potential near edge of collisionless plasma, unified theory for, 20: 20041
theory of spherical, for plasma diagnostics, 20: 20073
use of Langmuir, in plasma diagnostics, (E), 20: 20007 (N-65-22196)
ELECTRODES
design for carrier-distillation analyses, 20: 18568(R) (NBL-230)
development and performance of paired, as magnetic spectrometers, 20: 18988(R) (BNL-929, pp 58-66)
development of porous nickel-matrix, for ion engines, 20: 18884(R) (N-65-22975)
ELECTROLYTES
effects on muscle contractions, 20: 18293 (NP-14898)
radiation effects on content of, in muscles, 20: 18293 (NP-14898)
ELECTROLYTIC POLISHING
process for, 20: 19186(P)
ELECTROMAGNETIC FIELDS
calculation for current initiation between parallel conducting planes, (T), 20: 19272 (AECL-2531)
charged-particle motion in varying, nonrelativistic equations for, 20: 19282
emission from nonlinear interactions of surface oscillations in plasma, (T), 20: 20035
infrared representations in quantum electrodynamics, Block-Nordsieck model for, 20: 19711

interactions with elementary particles, mechanism of CP violation in, (T), 20: 19578
plasma acceleration and electric conductivity in, 20: 20003 (N-65-1644?)
simulation atomic explosions, 20: 19109 (N-65-21748)
structure of, space-time, 20: 19707

ELECTROMAGNETIC LENSES
focusing aberrations in, second-order, (T), 20: 19278

ELECTROMAGNETIC SEPARATION
conference on, 20: 19141
contamination in, 20: 19145
of mercury and thallium radioisotopes from proton reactions with lead, 20: 19889

ELECTROMAGNETIC WAVES
effects of high-frequency, on phosphorus absorption by dog intestine, 20: 18219
emission from atomic explosions, system for simulation of, 20: 19109 (N-65-21743)
emission from electron-beam motion in helium plasma in magnetic fields, (E), 20: 20071
interactions of plane, in gaseous plasma, (E/T), 20: 20032
interactions with longitudinal waves in plasma, nonlinear, 20: 20021
production in inhomogeneous plasma, nonlinear second harmonic, (T), 20: 20038
propagation along plasma boundary, perpendicular to magnetic field, (T), 20: 20075
use in radiology, particle-wave dualism effects on, 20: 18546

ELECTROMAGNETISM
theory for, from Lorentz equations, 20: 19704
theory of, variational principles for, 20: 19276

ELECTROMETERS
design for detection of α and β activity in expired breath, 20: 18235

ELECTRON BEAMS
current density measurement using tungsten gauge, 20: 19277
dose distribution of, in irradiation of food, 20: 19127
dosimetry of, for tumor radiotherapy, 20: 18521
dosimetry of, for mammary carcinoma therapy, 20: 18545
effects on Ehrlich's adenocarcinoma, qualitative and quantitative, 20: 18396
effects on gold as function of energy, 20: 19270
effects on microorganisms, use in size estimations, 20: 18314
effects on polyacrylamide, 20: 18779
injection at 1.5 Mev into electron microscope, linear accelerator performance for, (E), 20: 19308
interactions with gases, plasma production during instability in, (E), 20: 20078
interactions with plasma, h-f oscillations from, (E), 20: 20079
monitoring at 10 Mev to 5 Bev, secondary emission foils for, 20: 19024 (DESY-65/16)
motion in helium plasma in magnetic fields, microwave electromagnetic radiation emission from, (E), 20: 20071
polarization by spin-exchange collisions with atomic beams, (E), 20: 19375
reactions with carbon dioxide molecular beams at 40 to 580 ev, effective ionization cross sections from, (E), 20: 19404
scattering by thick targets at 0.5 to 10 Mev, retrofugal flux from, (E), 20: 19394
scattering by thick targets at 1 to 10 Mev, energy spectra of retrofugal flux from, (E), 20: 19395

ELECTRON CAMERAS
design and performance of scintillation, 20: 19085

ELECTRON CAPTURE
theory, 20: 18557 (ORNL-TM-1409)

ELECTRON CAPTURE CROSS SECTIONS
measurement as function of electron energy, method for, 20: 18557 (ORNL-TM-1409)

ELECTRON MICROSCOPES
injector for, performance of 1.5-Mev linear accelerator as, (E), 20: 19308
voltage stabilizer for, design of accelerating, 20: 19323(P)

ELECTRON PAIRS
kinetics of plasma of, relativistic, (T), 20: 20050
photoproduction cross sections, nuclear magnetic effects on, (T), 20: 19968

ELECTRON SOURCES
development of laser-heated cathode, 20: 19283
electronic equipment for, design of, 20: 19032(R) (N-65-23928)

ELECTRON TUBES
development of high-temperature ceramic thyratrons, 20: 19416(R) (N-65-17881)
performance of magnetron, as ion source, 20: 19003

ELECTRONIC EQUIPMENT
contamination of heated and irradiated components by microbes, internal, 20: 18993 (N-65-24356)
design for electron sources and ion sources, 20: 19032(R) (N-65-23928)
development for AGS, 20: 19285(R) (BNL-929, pp 44-57)
radiation effects on components of, gamma and neutron, 20: 19098(R) (N-65-17953)
radiation effects on microcircuit digital gates, neutron, 20: 19100 (N-65-18004)
radiation effects on components of, research program on, 20: 19107(R) (N-65-21263)

ELECTRONS
accelerator design for, 20: 19320(P)
capture by hydrogen in plasma, radiative, (T), 20: 20047
capture by protons in reactions with atomic hydrogen, (T), 20: 19384
content and density in magnetospheric ionization knee, (E), 20: 19668
density and temperature in ionospheric F-region, (E), 20: 19643 (N-65-23662)
density distribution in plasma, measurement using microwaves, 20: 20012 (N-65-27813)
density distribution in ionospheric equatorial F2 region, (T), 20: 19653
density distribution in ionospheric F2 layer, power series for, 20: 19656
density in decaying plasma afterglows, time-resolved microwave interferometry for, 20: 20054
density in glow discharge hydrogen plasma between coaxial dielectric cylinders, (T), 20: 20068
density in helium plasma, measurement using open cylindrical resonators, 20: 20072
density in ionosphere, sunspot activity correlations with, 20: 19647
density in ionospheric F2 region, solar flare effects on, 20: 19663
density near satellite, proton-whistler determination of, (E), 20: 19669
distribution in rare gases, Thomas-Fermi-Dirac equation for, 20: 19366
effects on absorption spectrum and resistivity of n-type germanium, 20: 19094 (INR-657/II/PL)
effects on electron paramagnetic resonance spectra of strontium nitrate, 20: 18739
effects on iodomethane in cyclohexene, tracer studies of, 20: 18771
effects on optical properties of spacecraft temperature-control coatings, 20: 19259
effects on p-type silicon solar cells, defects from, 20: 19114
effects on p-type silicon solar cell temperature dependence of damage from, 20: 19115
effects on polyvinyl chloride, in air and vacuum, 20: 18762
effects on silicon solar cells, energy dependence of, 20: 19105 (N-65-19870)
effects on silicon, energy dependence of, 20: 19106(R) (N-65-19886)
effects on spiraling-mirroring domain of electric field geomagnetically trapped, 20: 19660
effects on structure of silicon, effects of impurities on, 20: 19102(R) (N-65-19693)
effects on structure of phosphorus-doped silicon, 20: 19108(R) (N-65-21459)
effects on structure of silicon, defect introduction rate of, 20: 19110(R) (N-65-21762)
emission from metal surfaces bombarded by lithium atoms and ions at 20 to 60 kev, secondary, (E), 20: 19363
energy spectra of auroral, 20: 19691
flux in geomagnetic fields at L = 2, diurnal variation and longitudinal dependence of trapped, (E), 20: 19680
interactions in plasma, quasisingle particle approximation for, 20: 20036
interactions with photons, theory of first-passage distributions for cascade, 20: 20101
interactions with antineutrinos and neutrinos, cross sections for, (T), 20: 19463
interactions with deuterons, neutron form factors from, (E), 20: 19509
interactions with protons, differential cross sections for elastic, (E), 20: 19526
interactions with photons at high energies, double logarithmic asymptotics of Compton, (T), 20: 19580
interactions with microwaves at cyclotron resonance, quantum mechanical properties of, 20: 19462
interactions with antineutrinos and neutrinos, polarization in, (T), 20: 19464
kinetics in plasma, nonlinear 13-moment approximation for run-away, 20: 20059
magnetic moment of, anomalous, (T), 20: 19525
pair correlation energies for oxygen, many-body perturbation theory for, 20: 19383
precipitation during negative magnetic bays, auroral electrojet correlations with, (E), 20: 19673
precipitation in auroral zone, radiowave broadbeam absorption correlation with, (E), 20: 19685
precipitation spectra in auroral zone D-region, cosmic noise absorption and bremsstrahlung x ray measurements for determinations of, (E), 20: 19672
production by laser-beam cathode heating, 20: 19283

properties of gases of, 20: 19468
radiation from accelerated, analysis of bremsstrahlung and Cherenkov, 20: 19455
reactions in topside ionosphere, heating mechanism for, (T), 20: 19651
reactions with excited hydrogen atoms, high-energy excitation cross sections for, (T), 20: 19401
reactions with helium at 19.8 to 23.2 ev, excitation of n = 2 states in, (E), 20: 19388
reactions with helium, single and double ionization in, (T), 20: 19398
reactions with magnesium and sodium, ionization cross sections for, (T), 20: 19400
reactions with rubidium, energy losses in, (E), 20: 19393
scattering by atoms, review of theories for resonances in, 20: 19361
scattering by atoms at low energies, relativistic effects in, (T), 20: 19397
scattering by calcium-40 and -48 at 250 Mev, (E), 20: 19936
scattering by carbon-12 and oxygen-16, dispersion corrections for, (T), 20: 19825 (LAL-1153)
scattering by helium and hydrogen, quasibound negative-ion ground states in, (E), 20: 19387
scattering by hydrogen, Born amplitudes for inelastic, (T), 20: 19382
scattering by oxygen-16 at 43, 59, and 69 Mev, transverse form factors of excited states from inelastic, (E), 20: 19897
scattering by solid mercury at 300 ev, spin polarization from double-elastic, (E), 20: 19376
spectra from meson (μ) decay, (E/T), 20: 19503
stopping power of M, for charged particle, (T), 20: 19396
structure in quantum electrodynamics, Block-Nordsieck model for infrared, 20: 19711
synchrotron radiation from ultrarelativistic, in dipole field, 20: 19456
temperature in hot argon–potassium discharges, (E), 20: 20024
temperature in ionosphere, 20: 19648
temperature in plasma in electric field, acoustic instability effects of, (T), 20: 20067
temperature in solar wind, measurement of, (T), 20: 19349
temperature in theta-pinch deuterium plasma, effect of impurities on, (E), 20: 20046
temperatures in MHD channel in crossed fields, (T), 20: 20076
tracks in bubble chambers, bubble density along, 20: 19060
transport in electric fields, Boltzmann equation for, 20: 19585
transport through thin metal films, 20: 19097 (N-65-17886)

ELECTROPHORESIS
radiation effects on deoxyribonucleohistone, 20: 18789

ELECTROSTATIC FIELDS
operation of d-c beam-separating, for AGS, 20: 19285(R) (BNL-929, pp 44-57)

ELECTROSTATIC LENSES
focusing aberrations in, second-order, (T), 20: 19278

ELEMENTARY PARTICLES
book: *Strong Interactions and High Energy Physics*, 20: 19592
book: *Symmetry Groups in Nuclear and Particle Physics*, 20: 19591
classification of, using rotation symmetry, (T), 20: 19571
conference, 20: 19603
decay of, covariant phase-space integration for, 20: 19542
decay of, strangeness changing weak currents in leptonic, 20: 19577
detection using counter telescopes, 20: 19022 (CALT-68-62)
diffusion of, Boltzmann equation for, 20: 19584
Dirac base spinors for, CPT-invariant intertransformation rules for, 20: 19544
field theory for spin 0, ½, and 1, in finite space, 20: 19558
field theory for, spin and statistics relations from local rings in, 20: 19546
field theory for, criterion for interpretation of, 20: 19547
form factors for, electromagnetic, (T), 20: 19538 (IC-66/27)
interaction amplitudes for, analyticity and unitarity of, (T), 20: 19595
interactions and properties of, bibliography on, 20: 19804 (AED-C-12-13 (Pt.2))
interactions at high energies, Regge-pole theory of, (E/T), 20: 19597
interactions at high energies, multiperipheral model for, (T), 20: 19598
interactions at high energies, review on strong, (T), 20: 19609
interactions in many-body systems of, (T), 20: 19274 (N-65-16830)
interactions of nonstrange, weak, (E/T), 20: 19440 (ANL-7130, pp 337-71)
interactions of nonleptonic, weak, (T), 20: 19532 (ANL-7130, pp 421-9)
interactions of relativistic, irreducible representations of Poincaré group for coupling and recoupling, 20: 19552
interactions of three-body systems of, (T), 20: 19600
interactions of, analyticity test for amplitudes in complex angular momentum plane, 20: 19567
interactions of, approximate symmetries in strong, (T), 20: 19610
interactions of, conference on weak, 20: 19426 (ANL-7130)
interactions of, convariant phase-space integration for n-body final-state, 20: 19542
interactions of, complex angular momentum in, (T), 20: 19596
interactions of, CP violation in, (T), 20: 19608
interactions of, C, P, T violations in weak, (T), 20: 19611
interactions of, discontinuities of Feynman graphs for, (T), 20: 19582
interactions of, determinantal formulation of theory of multichannel, 20: 19599
interactions of, Feynman diagrams and rules for geophysical analogies of, 20: 18936
interactions of, generalized Regge representation for amplitude of, 20: 19588
interactions of, isospin conservation in strong, (T), 20: 19581
interactions of, phenomenological analysis of, 20: 19540 (UCRL-14647-T)
interactions of, review of weak, 20: 19459
interactions of, review on electromagnetic, 20: 19529
interactions of, symmetry models for strong, 20: 19273(R) (BNL-929, pp 3-43)
interactions of, substitution law for, 20: 19586
interactions of, S-matrix theory of, 20: 19594
interactions of, S-matrix theory of, 20: 19606
interactions of, S-matrix theory of, 20: 19593
interactions of, testing T invariance by, (T), 20: 19601
interactions with photons, mechanism of CP violation in, (T), 20: 19578
mass formula in SU(n) symmetry, 20: 19561
mass relations of strongly interacting, 20: 19273(R) (BNL-929, pp 3-43)
mass spectra of, (T), 20: 19534 (IC-66/19)
model for strongly interacting, quark, (T), 20: 19531
models for, bootstrap, (T), 20: 19523
models for, bootstrap, (T), 20: 19607
momentum conservation in unphysical theories in SU(6) for, angular and multicomponent, 20: 19543
motion in gravitational fields, extended mass, (T), 20: 19698 (NP-15931)
photoproduction, (T), 20: 19447 (UCRL-14614-T)
representation in Poincare group for nonzero rest mass, L-S basis for, 20: 19550
scattering amplitude for, analyticity of, (T), 20: 19605
scattering of, model of high-energy elastic, 20: 19273(R) (BNL-929, pp 3-43)
scattering of, 3-particle resonances in, 20: 19273(R) (BNL-929, pp 3-43)
spin coupling and intrinsic symmetry in infinite-dimensional, Lie algebras for, 20: 19562
structure of, space-time, 20: 19707
symmetries of, status of, 20: 19612
symmetry for, degenerate principal series of SL(3,R), 20: 19548
symmetry for, finite groups in unitary, 20: 19560
symmetry for, representations and couplings for U(6,6) tower, 20: 19535 (IC-66/23)
symmetry for, review of CPT theorem in, 20: 19583
symmetry models for, relativistic broken, (T), 20: 19604
theory for, CP invariance in mirror particle, 20: 19587
theory for, energy operator of de Sitter world, 20: 19570
theory for, uses of algebra of currents, 20: 19541 (UR-875-121)
theory of quarks, 20: 19571
theory of, nuclear physics analogies in, 20: 19994
uncertainty principle for relativistic, 20: 19700

ELEMENTS
determination of trace, in marine animals and plants off Puerto Rico, 20: 20360(R) (PRNC-73)
preparation and properties of synthetic, 20: 18649
spectra of heavy, atomic, 20: 20365
synthesis in γ Pavonis and ζ^1 Reticuli subdwarfs, underabundance in, (T), 20: 19337

EMBRYONIC TISSUES
radiation effects on infection by Rous sarcoma virus, 20: 18321

EMBRYOS
radiation effects on mouse, teratologic, 20: 18404
radiosensitivity of, effects of actinomycin on, 20: 18461

EMISSION SPECTRA
line broadening of, theory for Doppler and pressure, 20: 19619 (UCRL-16635)

ENDOCRINE GLANDS
function studies on, tracer techniques for, 20: 18530
radiation effects on functions of, 20: 18530
radiotherapy of tumors of, 20: 18530

ENDOXAN
effects on rats, leukopenic, 20: 18504

ENERGY
sources of, for desalination of water, evaluation of, 20: 18704
transfer of radiation, in biological systems, molecular, 20: 18274

ENZYMES
complex formation with metal-binding radioprotective compounds, 20: 18450

distribution in pancreas, 20: 18184(R) (BNL-929, pp 115-25)
effects of disulfides and thiols on glutathione reductase, biochemical, 20: 18453
effects on beating and growth of cultured heart cells, 20: 18210(R) (UCLA-12-576, pp 15-25)
effects on lipid metabolism in chickens, 20: 18295(R) (UCLA-12-576, pp 27-56)
preparation of purified polymerases, 20: 18205(R) (LA-3432, pp 178-262)
properties of polymerases, 20: 18205(R) (LA-3432, pp 178-262)
radiation effects of photon K-absorption on, 20: 20360(R) (PRNC-73)
radiation effects on composition and function of carboxypeptidase, uv, 20: 18250
radiation effects on structure of carboxypeptidase, uv, 20: 18251
radiation effects on activity of glutamic-oxalacetic transaminase, in mouse spleen tissues, 20: 18280
radiation effects of rat leukocytic, effects of B vitamins on beta, 20: 18499
reaction of, involved in nucleotide synthesis, 20: 18205(R) (LA-3432, pp 176-262)
reactions in liquids, mechanism of reversible intermediate, 20: 18556(R) (BNL-929, pp 66-82)

EPIDEMIOLOGY
of dengue fever in Puerto Rico, 20: 20360(R) (PRNC-73)

EPITHELIUM
radiation effects on mitosis duration in turtle intestinal, effects of temperature on gamma, 20: 18291(R) (N-65-17058)
radiosensitivity of buccal, 20: 18523

EQUIPMENT AND PROCEDURES
book: *Nuclear Physics Detection Instruments and Their Application*, (In Chinese), 20: 19086

ERBIUM
effects on x-ray fluorescent spectrometric determination of yttrium, 20: 18611
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599

ERBIUM ALLOYS
Er–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Er–Ge, preparation and crystal structure of ErGe, 20: 19224
Er–Mn, magnetic structure of intermetallic compound $ErMn_2$ in, 20: 18556(R) (BNL-929, pp 66-82)

ERBIUM ISOTOPES Er-160
beta decay of, Auger electrons from, (E), 20: 19958

ERBIUM ISOTOPES Er-166
energy levels from thulium-166 decay, (E), 20: 19954
energy levels of, high-spin rotational, (E/T), 20: 19953

ERBIUM SILICIDES
preparation and crystal structure of, 20: 19224

ERBIUM SULFIDES
Cu_2S–Er_2S_3, phase studies, 20: 18644

ERYTHROCYTES
cell sizing of, electronic equipment for, 20: 18198
content of photoporphyrin in duck, 20: 18184(R) (BNL-929, pp 115-25)
effects of disulfides and thiols on, biochemical, 20: 18453
enzyme synthesis in, 20: 18198
radiation effects on mouse, β, 20: 18353
radiosensitivity of membranes of, effects of temperature on, 20: 18454
radiosensitivity of, effects of iodoacetic acid and related compounds on, 20: 18468

ERYTHROPOIESIS
effects of atmospheric oxygen content and pressure on, 20: 18295(R) (UCLA-12-576, pp 27-56)
effects of chemicals on rat, effect of erythropoietin on, 20: 18500
radiation effects on, in mice, γ, 20: 18289(R) (LA-3432, pp 56-101)
radiation effects on rat, effects of erythropoietin on, 20: 18500
radiation effects on, after telecobalt therapy for cancer, γ, 20: 18526
tracer study in mice, 20: 18304

ERYTHROPOIETIN
content in urine, effects of anemia on, 20: 18190(R) (UCRL-16613)
effects on erythropoiesis in chemically treated and irradiated rats, 20: 18500

ESCHERICHIA COLI
desoxyribonucleic acid replication in thymine-less, tracer study of mechanism for, 20: 18231
effects of L-glucose on growth, 20: 18206(R) (N-65-16815)
endotoxin of, radiosensitivity effects in mice, 20: 18496
infection by phage DNA, mechanism of, 20: 18204(R) (LA-3432, pp 130-77)
mutants of, absence of K-reactivation in recombination-deficient, 20: 18315
phage production in, effects of vibrations on, 20: 18363
radiation effects on, photoreactivation of uv, 20: 18315
radiation effects on RNA phage replication in, uv, 20: 18316
radiation effects on phage production in, cosmic and γ, 20: 18363
radiation effects combined with vibrations on phage production in, γ, 20: 18363
radiation effects on transfer RNA in, uv, 20: 18249
radiation effects on, effects of strain on γ, 20: 18313
radioinduced inactivation of resistance transfer factor episome in, beta and gamma, 20: 18254
radiosensitivity of, effects of 5-bromouracil on γ, 20: 18295(R) (UCLA-12-576, pp 27-56)

ESOPHAGUS
radiotherapy of carcinomas of, 20: 20360(R) (PRNC-73)
radiotherapy of cancer of, effects on lungs of γ, 20: 18346

ESTROGENS
effects on lipid metabolism in chickens, 20: 18295(R) (UCLA-12-576, pp 27-56)
excretion of tritium-labeled, after injection of labeled testosterone, 20: 18230

ETHANE
reactions with deuterium and tritium ions, spectral studies on, 20: 18657
yields from radiolysis of iodomethane in cyclohexene, tracer studies of, 20: 18771
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)

ETHANE, BROMO-
reactions of recoil carbon-11 with deuterated, yields of acetylene from, 20: 18714

ETHANE, CHLORO-
reactions of recoil carbon-11 with deuterated, yields of acetylene from, 20: 18714

ETHANE, FLUORO-
reactions of recoil carbon-11 with deuterated, yields of acetylene from, 20: 18714

ETHANE, IODO-
reactions of recoil carbon-11 with deuterated, yields of acetylene from, 20: 18714

ETHANE, NITRO-
reduction in organic solvents, effects of hydrogen ion concentration on, 20: 18636(R) (TID-22725)

ETHANETHIOL, 2-AMINO-
complex formation with metalloenzymes in mouse cells, 20: 18450
effects on biological systems, chemical, 20: 18453
effects on irradiated mice, delayed toxic, 20: 18488
effects on leukopenia in rats, 20: 18504
effects on mitosis in liver cells of partially-hepatectomized rats, 20: 18457
effects on normal tissues and tumor growth, 20: 18475
effects on phosphorus-32 and sulfur-35 uptake by bone, 20: 18479
effects on response of rat blood pressure to adrenaline and acetylcholine, 20: 18239
effects on sensitivity of cells to nitrogen mustard, 20: 18462
radiosensitivity effects on mice, mechanisms for x, 20: 18431
radiosensitivity effects of, reaction mechanisms for, 20: 18274
radiosensitivity effects in organic systems, reaction mechanisms for, 20: 18276
radiosensitivity effects on animal cells, 20: 18444
radiosensitivity effects of, reaction mechanisms for, 20: 18450
radiosensitivity effects in rats, x, 20: 18457
radiosensitivity effects in mice, 20: 18473
radiosensitivity effects on rabbit eyes, 20: 18476
radiosensitivity effects in mice, 20: 18488
radiosensitivity effects in mice, 20: 18491
radiosensitivity effects of, combined with 5-BUdR in mice, x, 20: 18498
radiosensitivity effects on yeast, 20: 18503 (AD-611869, pp 169-83)
radiosensitivity effects on rat tumors, 20: 18533

ETHANOL
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
radioinduced thermoluminescence of, at 77°K, role of molecular motions in, 20: 18760
Ar–ethanol, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)

ETHER, BIS(2-CHLOROETHYL)
solvent properties for iron in hydrochloric acid solutions, effects of acid and iron concentrations on, 20: 18571 (ORNL-TM-1420)

ETHERS
germyl methyl, yields in mercury sensitized photolysis of germane and silane systems, 20: 18729(R) (NYO-2007-9)

ETHYL ETHER
radiation effects on ion mobilities in, 20: 18724 (BNL-10012)

ETHYLAMINE, 2,2'-DITHIOBIS-

effects on biological systems, chemical, 20: 18453
effects on metabolism in yeast, 20: 18372
effects on metabolism in mice, 20: 18240
radiosensitivity effects on yeast, 20: 18372
radiosensitivity effects on mice, mechanisms for x, 20: 18431
radiosensitivity effects on mice during simulated space flight, gamma, 20: 18443

ETHYLENE
radioinduced polymerization of, parameters and products of gamma, 20: 20177(R) (BNL-929, pp 83-105)
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742
reactions with carbon-11, hydrogen, and methyne, 20: 18716
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
CO–ethylene, radioinduced polymerization of, parameters and products of gamma, 20: 20177(R) (BNL-929, pp 83-105)
D–ethylene, yields in mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)

ETHYLENE, CHLORO- POLYMERS
radiation effects on, in air and vacuum, electron, 20: 18762

ETHYLENE, CHLOROTRIFLUORO-
radiation effects on dielectric constants and paraelectric susceptibility of, 20: 19266

ETHYLENE, CHLOROTRIFLUORO- POLYMERS
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)

ETHYLENE, DIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

ETHYLENE GLYCOL
yields from gamma radiolysis of methanol, effects of catalysts on, 20: 18744

ETHYLENE POLYMERS
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
effects of abdominal shielding of, on survival of irradiated rats, 20: 18441
neutron scattering by, cross sections for slow, (E/T), 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
preparation of deuterated targets of, 20: 18692
radiation effects on dielectric constants and paraelectric susceptibility of, 20: 19266
radioinduced allyl free radical formation in, 20: 18756
radioinduced crosslinking on pipejoints, 20: 19129(P)
use on pipe joints, 20: 19129(P)

ETHYLENE, TETRAFLUORO- POLYMERS
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
radiation effects on dielectric constants and paraelectric susceptibility of, 20: 19266

ETHYLENE, TETRAPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

ETHYLENE, TRIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

ETHYLENEDIAMINE COMPLEXES
with cobalt nitrate, radiation effects on cobalt-58 retention in aqueous solutions and solid state of, 20: 18725 (IS-T-73)
with cobalt, reactions of recoil cobalt atoms in, thermal annealing-decomposition competition in, 20: 18765
with cobalt, Szilard-Chalmers reactions of, on ion exchanger, 20: 18764

EUGLENA
radioinduced inactivation of green colony-forming ability in, photoreactivation of uv, 20: 18253

EUROPEAN ATOMIC ENERGY COMMUNITY
regulations for transport of radioactive materials, 20: 18940 (EUR-2747.f)

EUROPIUM
determination of, gravimetric micro-, 20: 18581
separation from americium and curium by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
vapor pressure of solutions of, in liquid ammonia at −75.9°C, 20: 18689

EUROPIUM ALLOYS
Eu–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225

EUROPIUM COMPOUNDS
cyclopentadienide, preparation and stability of, 20: 18699
hexaammoniate, preparation and properties of, 20: 18689

EUROPIUM IONS
fluorescence in polycrystalline yttrium orthovanadates, 20: 20119

EUROPIUM ISOTOPES Eu-146
conversion electron spectrum, (E), 20: 19961

EUROPIUM ISOTOPES Eu-154
orientation in cerium magnesium nitrate, quadrupole coupling constants from, (E), 20: 20146

EUROPIUM SULFIDES
nuclear spin-lattice relaxation at 0.05 to 0.15°K, (E/T), 20: 19273(R) (BNL-929, pp 3-43)

EVAPORATORS
performance for processing Purex waste solutions, 20: 20344 (BNL-10047)
steam cycles for desalting flash, feasibility of fossil-fueled and nuclear, 20: 20291

EXPERIMENTAL BREEDER REACTOR-II
fuel element failure detection system, 20: 19018(R) (ANL-7110, pp 231-310)
fuel meltdown studies in TREAT, 20: 20229(R) (ANL-7110, pp 99-229)
fuel processing for, 20: 20183
kinetics, 20: 20229(R) (ANL-7110, pp 99-229)

EXPERIMENTAL GAS COOLED REACTOR
accident analysis, 20: 20257 (TID-22746)
containment vessel electrical penetrations, periodic test methods for, 20: 20266 (TID-22770)
control rod ejection from, accident consequences of, 20: 20254 (TID-22743)
control rod worths in, 20: 20252 (TID-22741)
control systems for, coolant system rate-of-change-of-pressure trip, 20: 20264 (TID-22760)
coolant depressurization accident procedures, 20: 20256 (TID-22745)
coolant pressure differential and loss rate from ruptures in primary cooling system, 20: 20251 (TID-22740)
coolant system failures in, control rod levitation from, 20: 20250 (TID-22739)
cooling system of, stress analysis and testing of, 20: 20249 (TID-22738)
core vibrations in, analysis of, 20: 20259 (TID-22749)
kinetics following cooling system depressurization accident, 20: 20262 (TID-22755)
loading machine for, design and performance of, 20: 20244 (ORNL-TM-1419)
neutron kinetics in, determination using noise analysis techniques, 20: 20260 (TID-22753)
reactivity of, kinetics of period measurements for determining, 20: 20265 (TID-22768)
reactivity temperature coefficients for, 20: 20253 (TID-22742)
service system for, failures in, 20: 20247 (TID-22694)
shutdown system for, rate-of-change-of-pressure emergency, 20: 20261 (TID-22754)
site selection factors, 20: 20255 (TID-22744)
steam generator failure from cooling system depressurization, 20: 20258 (TID-22748)

EXPLOSIONS
shock propagation from TNT detonation at ground level, precursor, 20: 18923 (N-65-22654)

EXPONENTIAL PILES
coolant boiling simulation in LEAD, using injected air, (E), 20: 20216
design and operation of LEAD, for determining microscopic reactor parameters, 20: 20215
neutron buckling and reaction rate measurements in graphite moderated plutonia-urania fueled, 20: 20197 (AEEW-R-438)
neutron diffusion in parallel-slab, 20: 20195 (AAEC/TM-302)
neutron flux distribution in, 20: 20201(R) (ANL-7110, pp 311-401)
use in determination of microscopic reactor parameters, (E/T), 20: 20214

EYES
radiation effects on reactions of, in labyrinthectomized rabbits, γ, 20: 18338
radiation effects on lens opacity of mouse, x, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on cytochrome c in, x, 20: 18261(T)
radiation effects on rabbit, effects of chemical radioprotective compounds on, 20: 18476

F

FALLOUT
alpha activity in, Oct. 15 to 29, 1965, identification of, 20: 18910
analysis of, autoradiographic, 20: 18916

content in human bones in Scotland and United Kingdom, 20: 18922
content in human body, September 1962 to August 1963, 20: 18961
effects and deposition patterns of, research on, 20: 18198
effects on Marshallese, annual survey for 1965, 20: 18185(R) (BNL-929, pp 126-47)
effects on Rongelap Islanders, 20: 18198
measurement in Puerto Rican rain forest, 20: 20360(R) (PRNC-73)
monitoring along 80th meridian (west) 1964, 20: 18967
monitoring at Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)
monitoring in Colorado, 1962 through 1964, 20: 18919
monitoring in Japan, January to March 1965, 20: 18921
monitoring in North America, 1965, 20: 18914
monitoring in North America, 1965, 20: 18915
monitoring in North America, 1965, 20: 18918
monitoring programs of U. S., 1963 to 1965, 20: 18980
radiation dose from nuclear-attack, 20: 18938 (AD-629784)
radionuclide fractionation in, from high-altitude explosions, 20: 18912
radionuclide fraction in, from vented underground explosion, 20: 18913

FAST CERAMIC REACTOR
development of fuels for, 20: 20183

FAST REACTORS
criticality studies, 20: 20229(R) (ANL-7110, pp 99-229)
design concepts for breeder, physics of, 20: 20240 (LA-DC-7739)
development and engineering studies on settled-bed, 20: 20177(R) (BNL-929, pp 83-105)
fuel cycle studies for power-breeder, 20: 20229(R) (ANL-7110, pp 99-229)
fuel elements for, development of, 20: 20183
fuels for, comparison of uranium-233 and -235, 20: 20177(R) (BNL-929, pp 83-105)
kinetics of power-breeder, research progress on, 20: 20229(R) (ANL-7110, pp 99-229)
kinetics of two-zone, computer programs for analysis of, 20: 20211 (ZfK-TPh-17)
kinetics of, dependence on thermal properties of uranium dioxide, 20: 20201(R) (ANL-7110, pp 311-401)
reactivity of, Doppler coefficient of, 20: 20201(R) (ANL-7110, pp 311-401)
uses of mixed plutonium uranium carbides as fuel for, 20: 19183

FATS
metabolism of, tracer study on, 20: 20360(R) (PRNC-73)

FATTY ACIDS
metabolism by animal cells in culture, 20: 18210(R) (UCLA-12-576, pp 15-25)
metabolism of nonesterified, 20: 18184(R) (BNL-929, pp 115-25)

FERMIONS
properties of gases of, 20: 19468

FERRITES
demagnetization of, using shock waves, 20: 20365

FERROMAGNETIC MATERIALS
Mössbauer effect in, line-shape theory for, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
neutron inelastic scattering in impurity-containing, (T), 20: 20158

FETUSES
radiation effects on mouse, protective effects of splenectomy against x, 20: 18436

FIBRINOGEN
radiation effects on deposition of injected, tracer study in rats of x, 20: 18294(R) (TID-22766)

FIELD THEORY
analyticity in axiomatic, 20: 19605
elementary particle interactions in relativistic, isospin conservation in strong, 20: 19581
elementary particle interactions in, discontinuities of Feynman graphs for, (T), 20: 19582
energy operator in de Sitter world, 20: 19570
equations in, geometrization of complex scalar, 20: 19553
gauge invariance in, physical implications of, 20: 19563
Lee model in, functional formulation of, 20: 19557
localization of states in quantum, 20: 19545
model for complex scalar field in Euclidean quantum, 20: 19555
operators in momentum space for quantum, calculus of, 20: 19554
particle interpretation in, criterion for, 20: 19547
regularization in infrared region in quantum, indefinite metric from, 20: 19556
spin and statistics relations from local rings in, 20: 19546
spinor fields in relativistic, nonlinear, 20: 19589

FILMS
thickness measurements of uranium dioxide, nondestructive, 20: 19025 (EIR-86)

FILTERS
development and testing for radiochemical processing plant ventilation, 20: 18824(R) (EURAEC-1536)

FIRES
fission product release in sodium reactor coolant, 20: 20183

FISH
buoyancy of, effects of wax deposits on, 20: 18210(R) (UCLA-12-576, pp 15-25)
cesium-137 content in U. S. commercial, 1965, 20: 18973
ecology of, integrated research on, 20: 18198
radiopreservation of Pacific coast, gamma, 20: 19126

FISSION
nucleon pairing and shell effects on, review of, 20: 19992

FISSION CHAMBERS
calibration by coincidence counting, 20: 19018(R) (ANL-7110, pp 231-310)
uranium dioxide film thickness in, nondestructive method for measuring, 20: 19025 (EIR-86)

FISSION FRAGMENTS
angular distributions from uranium (n,f) reactions at 14 Mev, (E), 20: 19861
charge distribution studies, 20: 20338
effects on metal foils, 20: 20183
energy of, measurement using silicon semiconductor detectors, 20: 19070
mass distribution studies, 20: 20338
sources of, development of uranium, 20: 20177(R) (BNL-929, pp 83-105)

FISSION PRODUCTS
analysis of, using atomic absorption methods, 20: 18591
angular distributions from photon reactions with uranium-238 at 5.2 to 9.25 Mev, (E), 20: 19830 (NP-15055)
behavior of gaseous, in particle structure of nuclear fuel paste, 20: 20222
content and distribution in Pacific Ocean sediment cores, use in determining sedimentation rates and vertical mixing, 20: 18902 (RLO-1725-41)
diffusion from urania, review of mechanisms of gaseous, 20: 19184
diffusion in sintered urania, gaseous, 20: 19182
distribution in aluminum–urania dispersion fuels, 20: 19178(R) (IDO-17154)
distribution in Pacific Ocean near mouth of Columbia River, 20: 18902 (RLO-1725-41)
effects of inhaled, on animals and man, 20: 18198
measurement of radioisotopic, 20: 20177(R) (BNL-929, pp 83-105)
metabolism in cattle, sheep, and swine, 20: 18188(R) (ORO-635)
release in reactor accidents, hazards of, 20: 20183
separation of antimony and arsenic from other, rapid, 20: 18838
separation of plutonium and uranium from oxide, by fluid-bed fluoride volatility process, 20: 18821 (ANL-7077)
separation of technetium from molybdenum, by precipitation with tetraphenylarsonium perrhenate, 20: 18843
separation on-line using mass spectrometers, 20: 19887
separation using focusing chromatography, 20: 18601
sorption by clays in United Arab Republic, 20: 20350
transport in soils, tracer study, 20: 18188(R) (ORO-635)
transport in soils, effects of chelating agents on, 20: 18211(R) (UCLA-12-576, pp 88-111)

FISSIUM
effects on fluorination of spent fuels, 20: 18824(R) (EURAEC-1536)
fission–Pu–U, compatibility with cladding materials, 20: 20183

FLAVONOIDS
radiosensitivity effects on mt tumors, 20: 18533

FLUID FLOW
boiling in, phase velocity distribution for, (T), 20: 18874
electric-field effects on turbulent charged, in nonconducting plane channel, (T), 20: 19637
heat transfer in two-phase, model for, (T), 20: 18863 (EURAEC-1360)
jet evolution in MHD, (E), 20: 19625
kinetics of, computing technique for determining, 20: 18866 (LA-3425)
magnetohydrodynamic, properties of two-dimensional nonstationary, (T), 20: 19624
pressure drop and void fraction measurements in two-phase co-current annular-mist, (E/T), 20: 18869(R) (NYO-3114-10)
pressure drop in boiling-water reactors, 20: 20263 (TID-22758)
rotating, variational principle for relativistic, 20: 19635
shock propagation in relativistic MHD, (T), 20: 19623

FLUID FLOW (LAMINAR)
velocity field of Newtonian, computer program for axial component of, 20: 18865 (LA-3418)

FLUID FLOW (TURBULENT)
heat transfer in sub- and supercritical water, high flux, 20: 18862 (COO-1177-19)
heat transfer to confining pipes, (T), 20: 18873 (UCB-34P64-1)
heat transfer to near critical water, (E), 20: 18861 (COO-1177-18)
magnetohydrodynamic, in presence of Hall effect, (T), 20: 19634

FLUIDS
mechanics of, eigenfunctions of Liouville operator for, 20: 19280
rotation of, variational principle for relativistic, 20: 19635
FLUORIDE VOLATILITY PROCESSES
development for ceramic fuel processing, computer program for use with, 20: 18820 (ANL-6992)
development for stainless steel-clad uranía fuels, 20: 20177(R) (BNL-929, pp 83-105)
development of fluid-bed, for plutonium and uranium separation from ceramic fuels, 20: 18821 (ANL-7077)
FLUORINE
determination in samples containing oxygen, activation, 20: 18568(R) (NBL-230)
nuclear magnetic resonance spectra in uranium hexafluoride, anisotropy of chemical shift of, 20: 18706
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
separation from gas streams, methods for, 20: 18824(R) (EURAEC-1536)
spin-spin relaxation in lanthanum fluorides at 100 to 560°C, (E), 20: 20149
thermal conductivity of liquid, 20: 19614 (N-65-17283)
FLUORINE ISOTOPES F-18
decay curve for mixture of carbon-11 and, resolution of, 20: 19074
energy levels, (E), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of, lifetimes of 937- and 1082-kev, (E), 20: 19918
production by alpha bombardment of water at 30 Mev in cyclotron, 20: 18809
FLUORINE ISOTOPES F-19
alpha reactions (α,d) and (α,t) at 28.6 Mev, momentum spectra from, (E), 20: 19876
alpha reactions (α,p) at 1.3 to 2.6 Mev, energies and strengths of resonances in, (E), 20: 19938
alpha reactions (α,t) with, mechanism of direct, (T), 20: 19947
energy levels, (T), 20: 19984
proton scattering at 13.9 Mev, excitation of ground-state rotational band in, (E/T), 20: 19921
FLUORINE SYSTEMS
F–HNO_3, solvent properties for thorium dioxide–uranium dioxide fuel particles, effects of metals and sulfate on, 20: 18819 (AAEC/E-143)
FLUOROCARBONS
radiation chemistry, 20: 20177(R) (BNL-929, pp 83-105)
FLUOSILICATES
molecular structure, 20: 18556(R) (BNL-929, pp 66-82)
FOILS
activity data for, computer program for processing, 20: 19018(R) (ANL-7110, pp 231-310)
FOOD
chains in marine systems, web diagram for, 20: 18198
radiation dose distribution in electron-irradiation of, homogeneity of, 20: 19127
radiation effects on rat consumption of, effects of chlorpromazine on x, 20: 18367
radioactive contamination in, survey, 20: 18976
radioactivity in, 1965, 20: 18918
radioactivity in, Jan. to July, 1965, 20: 18972
radioactivity in, 1963 to 1965, 20: 18980
radiopreservation of Dungeness crab meat at 33 and 42°F, 20: 19126
radiosterilization of grain, review of developments in, 20: 19123
radiosterilization of grain, pilot plant for, 20: 19124
radiosterilization of grain, pilot plant for, 20: 19125
strontium-90 content in U. S., 1962 through 1964, 20: 18915
FOOD IRRADIATION FACILITIES
feasibility of grain, 20: 19123
feasibility of grain, pilot plant for determining, 20: 19124
feasibility of grain, pilot plant for determining, 20: 19125
FORESTS
radiation effects on Puerto Rican rain, gamma, 20: 20360(R) (PRNC-73)
radiation effects on oak-pine, acute and chronic γ exposure, 20: 18421
radiation effects on, chronic γ, 20: 18211(R) (UCLA-12-576, pp 88-111)
FORMALDEHYDE
radioinduced polymerization in *n*-heptane and methylcyclohexane at −80°C, kinetics of, 20: 18777
yields from gamma radiolysis of methanol, effects of catalysts on, 20: 18744
FORMALDEHYDE POLYMERS
yields of, from gamma irradiation of formaldehyde at −80°C, 20: 18777
FORMAMIDE
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
FRANCIUM ISOTOPES Fr-223
energy levels from actinium-227 decay, (E), 20: 19864
FREE RADICALS
distribution on carbons from gamma radiolysis of dry ribonuclease, 20: 18749
electron spin resonance spectra of, from gamma-irradiated cyclohexanol, 20: 18758
identification and reactions of, in liquids, 20: 20365
properties of, effects on bioenergetic mechanisms, 20: 18185(R) (BNL-929, pp 126-47)
radioinduced in α-aminoisobutyric acid crystals at 77°K, ESR spectra of, 20: 18750
radioinduced in aqueous solutions, 20: 18449
radioinduced in DNA, γ, 20: 18275
radioinduced in liquid and frozen water, 20: 18190(R) (UCRL-16613)
radioinduced in Pisum meal, effects of water on, 20: 18429
radioinduced, role in radiation protection in biological systems, 20: 18274
reactions with AET in biological systems, 20: 18479
spectra of allyl, in irradiated polyethylene, uv, 20: 18756
stabilization energy of alkyl, 20: 18556(R) (BNL-929, pp 66-82)
stabilization mechanisms for, 20: 20365
FRENCH REACTORS
operation of, review of, 20: 20181(T) (AEC-tr-6644)
FRICTION
of mechanical components in space vacuum at high temperature, 20: 18891
FROGS
radiation effects on nitrogen metabolism in liver of splenectomized, gamma, 20: 18207 (NIJS-R-473)
radiation effects on nitrogen content and proteins in serum of, gamma, 20: 18243 (NIJS-R-454)
FRUITS
radiation effects on grapes, mutagenic, 20: 18409
radiation effects on papaya, gamma, 20: 18246(R) (UH-235PS-1, pp 7-13)
radiation effects on papaya, γ, 20: 18247(R) (UH-235PS-1, pp 14-25)
radiation effects on vitamin C content in papaya, 20: 18248(R) (UH-235PS-1, pp 52-4)
radiation effects on mango, effects of sterilization doses on gamma, 20: 18298(R) (UH-235PS-1, pp 39-46)
radiation effects on pineapple, gamma, 20: 18299(R) (UH-235PS-1, pp 47-51)
radiopreservation of papaya, gamma, 20: 18300(R) (UH-235PS-1, pp 55-74)
FUEL CELLS
use with radioisotope-fueled space power systems, 20: 19418 (N-65-22973)
FUNGI
nucleotides derived from mycelia of, effects on nitrogen mustard poisoning in mice, 20: 18452
FURAN, TETRAHYDRO-
effects on ion mobilities in irradiated hexane, 20: 18724 (BNL-10012)
FURNITURE
design for shelters, 20: 18946 (ORNL-TM-1428)
FUROCOUMARINS
chemical properties of, 20: 18466
photosensitivity effects on biological systems and human skin, 20: 18466
photosensitivity effects on animal cells in culture and viruses, 20: 18469
FUSED SALTS
free energies of mixing, 20: 20177(R) (BNL-929, pp 83-105)
properties and structure of, 20: 20365

G

GADOLINIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
effects on x-ray fluorescent spectrometric determination of yttrium, 20: 18611
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
separation from americium and curium by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
separation from other rare earths by partition chromatography using *bis*(2-ethylhexyl) phosphate, 20: 18837
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
GADOLINIUM ALLOYS

Co–Gd–Y, magnetic properties of intermetallic compounds of, (E/T), 20: 20141
Gd–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Gd–Ge, preparation and crystal structure of GdGe, 20: 19224

GADOLINIUM IONS
effects on EPR spectra of lanthanum bromides and lanthanum sulfate hydrates, 20: 18668

GADOLINIUM ISOTOPES Gd-154
energy levels of, high-spin rotational, (E/T), 20: 19953

GADOLINIUM ISOTOPES Gd-155
energy levels in, lifetime of excited, (E), 20: 19942
nitrogen-14 inelastic scattering by, Coulomb excitation in, (E), 20: 19959

GADOLINIUM ISOTOPES Gd-156
energy levels of, high-spin rotational, (E/T), 20: 19953
neutron capture cross section for, (E), 20: 19835 (SGAE-PH-35/1965)

GADOLINIUM ISOTOPES Gd-157
nuclear magnetic field measurement, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
use in neutron capture therapy, 20: 18508 (BNL-10038)

GADOLINIUM ISOTOPES Gd-158
energy levels of, high-spin rotational, (E/T), 20: 19953

GADOLINIUM ISOTOPES Gd-159
orientation in neodymium ethyl sulfate, quadrupole coupling constants from, (E), 20: 20146

GADOLINIUM SILICIDES
preparation and crystal structure of, 20: 19224

GADOLINIUM SYSTEMS
Gd–H_2O, neutron scattering in, reaction rate curves for, (E/T), 20: 19776 (AE-223)

GALAXIES
Cepheid distribution in large population-I-component, mechanism for primary maximum in classical, (T), 20: 19334
effects of quasi-stellar, on universe models, (T), 20: 19354
properties of radio, review of, 20: 19353
structure of radio, electron and plasma-jet components in, (T), 20: 19412

GALLIUM
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
properties of, effects of purity on electric and superconducting, 20: 19737
separation from rare earths by ion exchange chromatography, 20: 18827

GALLIUM ARSENIDES
properties of rare earth doped, electric and optical, 20: 20122
radiation damage in solar cells of, proton, 20: 19095 (N-65-16347)
radiation effects on photovoltaic parameters of solar cells of, proton, 20: 19106(R) (N-65-19886)

GAMMA CAMERAS
design and performance of scintillation, 20: 19085

GAMMA RADIATION
absorption in germanium, measurement of Fano factor and energy per hole-electron pair from, 20: 19077
absorption in thallium-activated sodium-iodide crystals at 122 kev to 2.62 Mev, peak-total ratios for, 20: 19075
absorption in well-type scintillation detectors, photofractions for, 20: 19076
amplification of coherent, using nuclear pumping, 20: 20201(R) (ANL-7110, pp 311-401)
attenuation factors for concrete and steel ducts, (E), 20: 20094 (NP-15926)
buildup factors for, empirical functions for, 20: 20097 (ORNL-RSIC-10)
detection and measurement of, performance of sulfuric acid solution containing iron for, 20: 18793
detection and measurement of, use of G-M tube in 8-decade counter for, 20: 19068
detection in rabbits, effects of biological differentiation of molybdenum-99 and technetium-99 on, 20: 18213
detection of low-energy, design of scintillation camera for, 20: 19089
detection of, automatic range changing monitor for, 20: 19017 (AECL-2533)
detection of, large-volume lithium-drifted germanium detector for, 20: 19072
detection of, Mössbauer spectrometer for, 20: 19050
detection of, scintillation camera for, 20: 19085
detection of, scintillation counters for, 20: 19090
dose rate behind laminated slabs, computer program for, 20: 20095 (ORNL-3805)
dose rates from KIWI Transient Nuclear Test, 20: 20294 (LA-3446)
dosimetry at interfaces, 20: 18952
dosimetry in thin phantoms, 20: 18977
dosimetry of wide-range, semiconductor detectors for, 20: 19015 (AD-629511)
dosimetry of, effects of bone geometry on soft-tissue, 20: 18978
dosimetry of, for tumor radiotherapy, 20: 18521
dosimetry of, for therapeutic use, 20: 18531
dosimetry of, for mammary carcinoma therapy, 20: 18545
dosimetry of, in ceramic coatings, 20: 18974
effects in Drosophila, genetic, 20: 18332
effects of oxidation of liquid cumene, effects of sodium hydroxide on rate of, 20: 18727 (JAERI-1100)
effects of, combined with labyrinthectomy on rabbit nervous system, 20: 18338
effects of, combined with vibrations on phage production in *E. coli*, 20: 18363
effects of, combined with magnetic fields on Drosophila behavior, 20: 18410
effects of, combined with x radiation on cervical cancer, 20: 18550
effects of, review of LET and RBE in, 20: 18362
effects on acetone, 20: 18737
effects on activity and ESR spectra of trypsin, 20: 18268
effects on allyl radical formation in polyethylene, 20: 18756
effects on aqueous solutions of oxyanion salts at 77°K, 20: 18748
effects on aromatic hydrocarbons in polycrystalline carbon tetrachloride, spectra of, resonance charge transfer in, 20: 18752
effects on artemia eggs, effects of moisture content and temperature, 20: 18342
effects on atactic and isotatic polypropylene in presence of nitrous oxide, 20: 18770
effects on Barkhausen effect triglycine sulfate and Rochelle salt, 20: 20174
effects on barley chromosomes, effects of dose on aberrant, 20: 18355
effects on barley seeds, effects of seed water on oxygen effect on, 20: 18389
effects on bean and soybean seed, genetic, 20: 18419
effects on binary mixtures of methanol, pyridine, and water, 20: 18736
effects on bronchial tumors, effects of radiomimetic substances on therapeutic, 20: 18534
effects on burros, pathological, 20: 18188(R) (ORO-635)
effects on cadmium sulfide photoelectric cells, 20: 19098(R) (N-65-17953)
effects on cattle, pathological, 20: 18188(R) (ORO-635)
effects on cellular reproduction in mouse tissues, survival curve analysis of, 20: 18370
effects on cervical carcinoma cells, host radiosensitivity determined by, 20: 18330
effects on chlorine-35 NQR in sodium chlorates, 20: 20118
effects on Clostridium spores, lethal, 20: 18340
effects on color of quartz, 20: 19261
effects on colorless and pigmented bacteria, lethal, 20: 18361
effects on crystalline 2-nitroaniline, chemical and physical properties of product formed by, 20: 18743
effects on cyclohexanol, ESR spectra of free radicals produced by, 20: 18758
effects on deoxyribonucleohistone, 20: 18789
effects on deuterated gaseous hydrocarbons, proton transfer reactions in, 20: 18742
effects on DNA, 20: 18275
effects on electronic phenomena in Rochelle salts, 20: 20175
effects on electronic components, research program on, 20: 19107(R) (N-65-21263)
effects on erythropoiesis in mice, acute double exposure, 20: 18289(R) (LA-3432, pp 56-101)
effects on erythropoiesis in cancer patients, 20: 18526
effects on *Escherichia coli*, reaction mechanisms in repair of, 20: 18313
effects on ESR spectra of alkali borate glasses, 20: 19256(R) (NYO-2024-9)
effects on ESR spectra of phosphate glasses, 20: 19256(R) (NYO-2024-9)
effects on ESR spectra of lead borate and lead silicate glasses, 20: 19256(R) (NYO-2024-9)
effects on ESR spectra of barbituric acid dihydrate monocrystals, 20: 18755
effects on ferricytochrome C reduction, hydroxyl radical effects on, 20: 18773
effects on goats, pathological and physiological, 20: 18401
effects on grain infestation, 20: 19125
effects on grain, disinfestation, 20: 19124
effects on grass seeds, effects of moisture content on, 20: 18382
effects on growth of tobacco seedlings and tissue cultures, 20: 18383
effects on immune reactions in mice, 20: 18190(R) (UCRL-16613)
effects on internal friction and piezoelectric modulus in potassium sodium tartrates, 20: 20173
effects on keratinization in squamous cell carcinomas following radiotherapy, 20: 18255
effects on laryngeal tissues, cytological, 20: 18311
effects on lipid metabolism in cotton seedlings, 20: 18374
effects on lithium, rubidium, and sodium sulfates, cation polarization

and hydrogen peroxide formation by, 20: 18782
effects on lungs following therapy for esophageal cancer, 20: 18346
effects on macromolecules, protective effects of ATP against, 20: 18259
effects on maize endosperm, mutagenic, 20: 18392
effects on mangoes, 20: 18298(R) (UH-235P5-1, pp 39-46)
effects on metabolism of lizards, chronic low-level, 20: 18211(R) (UCLA-12-576, pp 88-111)
effects on methanol in presence of catalysts, 20: 18744
effects on mice and rats, effects of nervous system activity on, 20: 18376
effects on mice during simulated space flight, effects of chemical agents on, 20: 18443
effects on mice, effects of shielding on, 20: 18441
effects on mice, effective residual dose measurements for, 20: 18289(R) (LA-3432, pp 56-101)
effects on mice, protective effects of chemical agents against, 20: 18440
effects on millipeds, 20: 18366
effects on mixtures of carbon tetrachloride or 2-propanol with olefinic compounds, yields in, 20: 18730 (UJV-1468)
effects on morphology and development of *Bombyx mori*, γ, 20: 18345
effects on mouse fertility, chronic low-level, 20: 18211(R) (UCLA-12-576, pp 89-111)
effects on mouse hematopoietic tissues, 20: 18364
effects on mutation frequency in tomato pollen, factors affecting, 20: 18393
effects on nitrogen metabolism in liver of splenectomized frogs, 20: 18207 (NIJS-R-473)
effects on nitrogen content and proteins in frog serum, 20: 18243 (NIJS-R-454)
effects on oxygen chemisorption by calcia and magnesia, 20: 18787
effects on ozone formation in air, 20: 18746
effects on papaya biochemistry, 20: 18246(R) (UH-235P5-1, pp 7-13)
effects on papayas, organoleptic tests of, 20: 18247(R) (UH-235P5-1, pp 14-25)
effects on papayas, preservative, 20: 18300(R) (UH-235P5-1, pp 55-74)
effects on paramagnetic defects in normal and deuterated ammonium sulfates, 20: 18761
effects on perithyroid tissues following thyroid cancer therapy, 20: 18358
effects on phase stabilization in ferroelectrics, 20: 20172
effects on photoperiodism in plants, 20: 18390
effects on physical properties of powdered gelatin, 20: 18775
effects on physiology of muscles, 20: 18293 (NP-14898)
effects on pineapple, effects of dose on, 20: 18299(R) (UH-235P5-1, pp 47-51)
effects on plant and tree growth, chronic low-level, 20: 18211(R) (UCLA-12-576, pp 88-111)
effects on plants, genetic, 20: 18420
effects on plants, genetic, 20: 18188(R) (ORO-635)
effects on pollen mother cells in maize, mutagenic, 20: 18335
effects on pollen, effects of plant nuclei size on, 20: 18384
effects on polymerization of carbon monoxide and ethylene, 20: 20177(R) (BNL-929, pp 83-105)
effects on polymerization of methacrylic acid, 20: 18794
effects on polymerization of chloroprene in presence of stabilizers, 20: 18795
effects on polymerization of vinyl acetate with sulfur dioxide, 20: 18774
effects on polymerization of formaldehyde in *n*-heptane and methylcyclohexane at −80°C, kinetics of, 20: 18777
effects on positive-hole migration in 3-methylpentane containing additives, 20: 18753
effects on potassium nitrosodisulfonate in aqueous solution, 20: 18767
effects on preservation of Dungeness crab meat at 33 and 42°F, 20: 19126
effects on properties of polyamide fibers, 20: 18747
effects on Puerto Rican rain forest, 20: 20360(R) (PRNC-73)
effects on rabbit eyes, effects of chemical radioprotective compounds on, 20: 18476
effects on rat mammary glands, effects of exposure fractionation and protraction on tumorigenic, 20: 18319
effects on reaction of isopropylbenzene on alumina–silica, 20: 18768
effects on resistance transfer factor episome in *E. coli*, inactivation, 20: 18254
effects on resonance charge transfer in carbon tetrachloride and solid solutions with aromatic amines, 20: 18751
effects on ribonuclease, free radical distribution from, 20: 18749
effects on rice seeds, genetic, 20: 18416
effects on rice seeds, genetic, 20: 18417
effects on *Schistosoma mansoni* cercariae, 20: 20360(R) (PRNC-73)
effects on seed weevils in mangoes, 20: 18298(R) (UH-235P5-1, pp 39-46)
effects on sheep, pathological, 20: 18188(R) (ORO-635)
effects on stilbene, effects of naphthalene, phenanthrene, and triphenylene on isomerization by, 20: 18735
effects on stomach cancers, effects of 5-fluorouracil on, 20: 18540
effects on sulfonic acid ion exchange resins, gaseous evolution in gamma, 20: 18728 (NIJS-R-458)
effects on swine, pathological, 20: 18188(R) (ORO-635)
effects on synthesis of ammonia, 20: 20177(R) (BNL-929, pp 83-105)
effects on tetrafluoromethane, 20: 18772
effects on thermoluminescence of organic solids, 20: 18760
effects on toxoplasma infections in meat, 20: 19122
effects on trees, genetic and morphological, 20: 18421
effects on turtle mitosis, effects of temperature on, 20: 18291(R) (N-65-17058)
effects on verrucous carcinoma of oral cavity, anaplastic, 20: 18547
effects on 2-propanol in presence of nitrous oxide and sulfuric acid, 20: 18766
emission by antimony and arsenic isotopes, 20: 18838
emission in beta decay, (T), 20: 19949
intensity relaxation narrowing of Mössbauer, (T), 20: 20153
production in proton reactions with carbon-13, 20: 19946
proton pair production from, substitution law test from coupling constant for, (T), 20: 19516
reactions (γ,n) in potassium iodate, retention of iodine-126 in, 20: 18726 (IS-T-74)
reactions (γ,n) with praseodymium-141 at 9.125 to 24.000 Mev, cross sections for, (E/T), 20: 19820 (IS-T-78)
reactions (γ,n) with tritium, angular distributions and total cross section for, (E/T), 20: 19868
reactions (γ,p) with oxygen-16 at 14 to 16 Mev, cross sections for, (E/T), 20: 19852
reactions (γ,p) and (γ,n) with helium-3 at 8.06 and 9.17 Mev, cross sections for, 20: 19946
reactions with nuclei, research at RC-1 reactor, 20: 20334
reactions with uranium-238 at 6.1 to 7.1 Mev, fission product angular distributions from, (E), 20: 19830 (NP-15055)
scattering by inhomogeneous materials at 14.4 kev, Mössbauer-effect measurements of narrow-angle multiple, (E), 20: 19904
scattering by liquids, kinetics studies using, 20: 19620
scattering of, experiment using low-activity sources for Compton, 20: 19049
spectrometry of, performance of lithium-drifted germanium detector in high-resolution, 20: 19087
transmission through homogeneous slabs, invariant imbedding method for albedo from, 20: 20102
transport of, computer programs for, 20: 20095 (ORNL-3805)
transport theory for, exponential transform for, 20: 20099 (ORNL-RSIC-14)
use for therapy of reticulosarcoma of mediastinum, late pathological effects, 20: 18519
use in measurement of nuclear level widths, 20: 19948

GAMMA SOURCES
contamination from cobalt-60, dosimetry of, 20: 18957
development for exposure of plants, 20: 18400
monitor for, design and performance of, 20: 19065
preparation of cobalt-60, for use in radiation chemistry, 20: 18732
preparation of, method for, 20: 18818(P)

GAMMA SPECTRA
analysis of, computer program for peaks in, 20: 19014 (AD-616703)
analysis of, from rain water samples, 20: 18907
evaluation of peaks in, 20: 19056

GAMMA SPECTROMETERS
design and performance of precision high-resolution Mössbauer, 20: 19050
design and performance of, for radiodiagnosis and radiotherapy, 20: 19084
design of scintillation, for 14-Mev neutron capture studies, 20: 19035 (NIJS-R-470)
development of Mössbauer, 20: 19847
performance of lithium-drifted germanium p-i-n, 20: 19061
performance of semiconductor, for scanning irradiated fuel elements, 20: 19080
performance of, for trace metal analysis in sea water, 20: 18576(R) (TID-22660)
resolution of lithium-drifted germanium, 20: 19087
use of semiconductor Compton, in burnup measurements on reactor fuel elements, 20: 19040 (SGAE-PH-33/1965)

GAMMA SPECTROSCOPY
development, 20: 20365

GARIGLIANO POWER REACTOR
coolant analysis and purification system, 20: 20276

GARNETS
magnetic structure of dysprosium aluminum, 20: 18556(R) (BNL-929, pp 66-82)

GAS COOLED REACTORS

criticality determination for heavy-water power, computer program for, 20: 20267 (UJV-1046)
criticality determination for heavy-water power, computer program for, 20: 20268 (UJV-1422)
iodine species interchange properties in, (E), 20: 19222 (TRG-Report-954)

GAS FLOW
heat transfer by turbulent, in parallel rod arrays, 20: 18876
kinetic model for two-component relativistic, 20: 19622
magnetohydrodynamic, shock stability in wedge, (T), 20: 19631
magnetohydrodynamic, compressibility effects in boundary layer on thermally insulated semi-infinite flat plate in, (T), 20: 19632

GAS FLOW (TURBULENT)
distribution ratio of heavy to light gas in vortex tube, (E/T), 20: 20293 (JPL-TR-32-808)

GASEOUS DIFFUSION PROCESS
isotope effect on surface diffusion flow in, 20: 19138

GASEOUS FUEL REACTORS
design concept for glow plug, 20: 20301 (NP-15906)
fuel containment in coaxial jet-MHD-driven vortex, (T), 20: 20299 (NP-15903)
fuel containment in rocket, using MHD-driven vortex, 20: 20300 (NP-15904)
fuel vortex flow in, study on, (E/T), 20: 20293 (JPL-TR-32-808)

GASES
effects on cathode thermionic emission, 20: 19229
electric conductivity of non-neutral inhomogeneous partially ionized, Ohm's law for, (T), 20: 20027
electric discharge in helium and neon, Tonks-Dattner resonance determination of sound wave propagation from, (E), 20: 20044
electric discharges in, time variations of current and spark-channel radius of, (T), 20: 19638
heating in cascade-arc jets, 20: 18882 (N-65-16890)
interactions in hard-sphere Bose, method of point transformations for, 20: 19633
kinetic model for two-component relativistic, 20: 19622
light absorption by, monochromatic nonlinear, (E/T), 20: 19628
location of, theory of neutron logging for, 20: 18932
microwave conductivity of slightly ionized, nonlinear, (T), 20: 19636
nuclear magnetic relaxation times in, h-f modulation and saturated scattering for measuring, 20: 19869
particle motion in nonuniform temperature fields, properties of, (T), 20: 18868 (NYO-2930-5)
positron reactions with, review of properties from, 20: 19460
radiolysis of molecular, ion yields and dose partition in, 20: 18754
reactions with condensed phases, bibliography on, 20: 18630 (NP-15896)
scattering in mass spectrometers, contamination from, 20: 19146
solubility in sea water, effects of physicochemical factors on measurements of, 20: 18632 (NYO-3450-1, pp 91-107)
spectra line broadening in, theory for, 20: 19619 (UCRL-16635)
transport properties of turbulent Lorentz, in magnetic fields, (T), 20: 19615 (N-65-19888)

GASTROINTESTINAL TRACT
radiation effects on, role of bile in developing, 20: 18327(T)
radiation effects on, 20: 18198
radiation effects on, following radium therapy of cervical cancer combined with telecobalt or x rays, 20: 18309
radioinduced syndrome in dog, effects of bile on, 20: 18185(R) (BNL-929, pp 126-47)

GEIGER-MUELLER TUBES
dead time and recovery time of, voltage dependence of, 20: 19088
design modification for increased range, 20: 19059
design of sterilizable, for use in space, 20: 19033 (N-65-26400)
development for detection and measurement of cosmic radiation in space, 20: 19029 (N-65-16933)
performance of, error statistics for, 20: 19053
use in floor monitor, 20: 19065
use in 8-decade gamma monitor, 20: 19068

GELATIN
radiation effects on physical properties of, gamma, 20: 18775

GENES
analysis of *Saccharomyces cerevisiae*, 20: 18194
analysis of Saccharomyces, 20: 18195

GENETICS
mechanisms for regulating Neurospora, 20: 18196
radiation effects on Drosophila, effects of dose on x, 20: 18324
radiation effects in mouse, after exposure for 35 generations, 20: 18289(R) (LA-3432, pp 56-101)
radiation effects on animal and plant, 20: 18198
radiation effects on *Medicago polymorpha*, x, 20: 18312
storage and transfer of genetic information, 20: 18185(R) (BNL-929, pp 126-47)

GEOCHEMISTRY
developments in marine, 20: 18633 (NYO-3450, pp 203-11)
marine, conference on, 20: 18199 (NYO-3450-1)
of bromine, chlorine, and iodine in aerosols, atmosphere, and rainwater, 20: 18202 (NYO-3450-1, pp 185-201)
research programs on, 20: 18555(R) (BNL-929, pp 66-82)
studies on lead isotopic composition in Baltic and Canadian Shield regions, 20: 18894 (NYO-3450-1, pp 169-84)
studies on sulfur isotopes in marine environment, 20: 18893 (NYO-3450-1, pp 131-48)

GEOLOGY
intrusion and metamorphism in rocks in western Connecticut and New York, 20: 18924(R) (NYO-1669-11)
stable isotope uses in, 20: 19120

GEOMAGNETIC FIELDS
activity correlations with trapped-electron diurnal variation, (E), 20: 19682
activity variation in, correlation with double sunspot-cycle, (E), 20: 19678
disturbances in, correlation with asymmetrical form of magnetosphere, 20: 19688
disturbances of, dependence on interplanetary magnetic field, (E), 20: 19642 (N-65-23066)
disturbances recorded at Byrd Station, Antarctica in winter 1962, (E), 20: 19641 (N-65-21748)
effects of bay disturbance of, on ionospheric F2 layer height variations, (E), 20: 19654
effects on carbon-14 content in atmosphere, (E), 20: 19684
effects on ionospheric F2-region equatorial anomaly, 20: 19658
electrojet structure in, bay and auroral substorm effects of polar, (E), 20: 19657
electron fluxes at L = 2, diurnal variation and longitudinal dependence of trapped, (E), 20: 19680
electron precipitation during negative magnetic bays, auroral electrojet correlations with, (E), 20: 19673
electron trapping in, electric field effects on spiraling-mirroring domain of, (T), 20: 19660
intensity variations of, correlation with electric currents in ionosphere, 20: 19659
intensity variations in, contour maps of diurnal, 20: 19664
intensity variations of, correlation with charged-particle precipitation in south auroral zone, (E), 20: 19686
intensity variations in, overhead current system approximation for quiet day transient, 20: 19689
intensity variations, correlation to cyclotron instabilities in hydromagnetic waves, (T), 20: 19666
properties of, review of, 20: 19645 (NASA-SP-97)
pulsations in, diurnal properties of horizontal micro-, (E), 20: 19676
pulsations in, phase characteristics of micro-, (E), 20: 19675
solar flare effects on, 20: 19662
structure, 20: 19694

GEOMAGNETIC STORMS
effects on ionospheric disturbances, sudden commencement, (E), 20: 19655
origin of, solar neutral hydrogen ejection theory for, 20: 19687

GERMANES
GeH_4–methanol, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)
GeH_4–SiH_4, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)

GERMANIUM
analysis for boron by deuteron or proton activation, 20: 18582
fabrication and performance of large-volume detectors of lithium-drifted, for gamma radiation, 20: 19072
fabrication of thin-window detectors of, method for, 20: 19043 (UCRL-16480)
gamma absorption in, measurement of Fano factor and energy per hole-electron pair from, 20: 19077
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
performance in semiconductor detectors, (T), 20: 19063
performance of lithium-drifted, in gamma spectrometry, 20: 19087
radiation effects on absorption spectrum and resistivity of n-type, electron, 20: 19094 (INR-657/II/PL)
x-ray absorption spectra of L shell in gaseous germanium chlorides, (E), 20: 19389

GERMANIUM ALLOYS
Ce–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Ce–Ge, preparation and crystal structure of CeGe, 20: 19224
Dy–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Dy–Ge, preparation and crystal structure of DyGe, 20: 19224

Er–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Er–Ge, preparation and crystal structure of ErGe, 20: 19224
Eu–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Gd–Ge, crystal structure of, at or near equiatomic proportions, 20: 19225
Gd–Ge, preparation and crystal structure of GdGe, 20: 19224
Ge–Ho, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Ho, preparation and crystal structure of HoGe, 20: 19224
Ge–La, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–La, preparation and crystal structure of LaGe, 20: 19224
Ge–Lu, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Nd, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Nd, preparation and crystal structure of NdGe, 20: 19224
Ge–Pm, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Pr, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Pr, preparation and crystal structure of PrGe, 20: 19224
Ge–Sm, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Sm, preparation and crystal structure of SmGe, 20: 19224
Ge–Tb, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Tb, preparation and crystal structure of TbGe, 20: 19224
Ge–Tm, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Yb, crystal structure of, at or near equiatomic proportions, 20: 19225

GERMANIUM CHLORIDES
germanium L-absorption spectrum in gaseous, (E), 20: 19389

GERMANIUM ISOTOPES Ge-73
oxygen ion reactions at 25 Mev, Mössbauer spectra from, (E), 20: 19832 (ORNL-P-1966)

GERMINATION
radiation effects combined with magnetic fields on plant, x, 20: 18388

GLASS
composition of waste-fixation, computer program for developing, 20: 20346 (ORNL-3824)
sorption of radioactive ions by surfaces of, effects of pretreatment on, 20: 18846
use of sintered iron sulfate, in simulated bone radiation dosimetry, 20: 18953

GLASS TEXTILES
radiation processing for permanently shaping, 20: 19130(P)
fiberglass–U, development of MTR-type fuel elements of, 20: 19178(R) (IDO-17154)

GLEEP
operation and maintenance of, problems in, 20: 20323

GLOBULIN
radiation effects on frog serum content, gamma, 20: 18243 (NIJS-R-454)

GLOVE BOXES
evaluation and testing of, standards for, 20: 18947 (RFP-343)
glove changing apparatus and method for, 20: 18987(P)

GLOW DISCHARGES
electron and ion densities between coaxial dielectric cylinders in hydrogen, (T), 20: 20068

GLUCOSE
effects on appetite regulation, neutron activation studies of, 20: 18198
effects on growth in *E. coli*, 20: 18206(R) (N-65-16815)
radiosensitivity effects on catalase, 20: 18449
transport in hamster intestine, effects of heavy water and water on active and passive, 20: 18212

GLUCURONIDES
radiation effects on urinary excretion of, by rats, x, 20: 18287 (EUR-2638.1)

GLUTAMIC ACID
labeling with carbon-14, 20: 18721

GLUTATHIONE
reactions with β-hydroxyethyl-2,4-dinitrophenyl disulfide, 20: 18722

GLYCEROL
neutron scattering by, review on, (E), 20: 19799

GLYCINE
conversion to cyanide by chromobacterium, tracer study of, 20: 18185(R) (BNL-929, pp 126-47)

GLYCINE, DIGLYCYL-
radiosensitivity effects on catalase, 20: 18449

GLYCINE SULFATES
radiation effects on phase stabilization in ferroelectric, gamma, 20: 20172
radiation effects on Barkhausen effect in, gamma, 20: 20174

GLYCOLS
polyoxyethylene, radiolysis of, gas chromatographic study of light products from, 20: 18741

GOATS
radiation effects on, chronic γ, 20: 18401

GOLD
deuteron reactions at 20 kev, penetration-depth distributions from, (E), 20: 20137
distribution in sea water, effects of depth on, 20: 18892 (NYO-3450-1, pp 41-89)
gold-198 ranges in, 20: 20136
krypton-85 ranges in, at 70 kev, (E), 20: 20134
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
neutron activation of, thermal, (T), 20: 19834 (SGAE-CH-24/1965)
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
neutron reactions with, gold-198 yields from thermal, (E), 20: 19878
radiation damage in, electron energy threshold for, 20: 19270
sorptive properties for krypton during evaporation and condensation, 20: 19255 (EUR-2749.e)
sputtering by argon ions at 20 kev, transparency model for, (E), 20: 19371
sputtering of oriented foils of, by rare earth ions at 50 kev, 20: 19372
use of foils of, as neutron flux monitors, 20: 19878
xenon-133 ranges in, 20: 20136

GOLD ALLOYS
Au–Fe, spectra at 4.2°K, Mössbauer hyperfine, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
Au–rare earth, preparation from amalgams by heating, 20: 19185

GOLD ISOTOPES Au-185
nuclear data, 20: 19882

GOLD ISOTOPES Au-197
neutron reactions (n,γ) and (n,n′) at 1 to 700 ev, spin of resonances in, (E), 20: 19866

GOLD ISOTOPES Au-198
calibration of, for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
determination by autoradiographic measurement of half life using ring oven methods, 20: 18584
dosimetry of, at various source distances, 20: 19091
energy levels from gold-197 (n,γ) and (n,n′) reactions, spin of, (E), 20: 19866
gamma emissions from, dosimetry in guinea pig organs, 20: 18975
production in irradiation of gold with thermal neutrons, (T), 20: 19834 (SGAE-CH-24/1965)
ranges in gold, 20: 20136
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
uptake by lymph nodes in dogs, 20: 18306
yields from thermal neutron reactions with gold, (E), 20: 19878

GONADS
radiation dose to, of medical personnel during radiographic procedures, 20: 18505
radiation effects on caterpillar, 20: 18329
radiation effects on concentration of oxidized and reduced TPN in rat, x, 20: 18343
radiotherapy of carcinomas of, effects on hematopoiesis, 20: 18552
radiotherapy of ovarian, followed by development of pelvic neoplasms, 20: 18397

GOODYEAR ATOMIC CORP., PORTSMOUTH, OHIO
environs monitoring, 1964, 20: 18914

GRANODIORITES
shock-pressure effects on mechanical and optical properties of, Hardhat event, 20: 18856

GRAPHITE
corrosion by gases and water at high temperatures, 20: 20183
diffusion of bromine and cesium in, 20: 20177(R) (BNL-929, pp 83-105)
mechanical properties at high temperatures, 20: 20183
neutron scattering by, thermal, (T), 20: 19781 (JAERI-1095)
preparation of kryptonated pyrolytic, by ion bombardment, 20: 18570(R) (NYO-2757-5)
radiation effects on dimensional changes in, effects of carbon black content on fast-neutron, 20: 19252 (BNWL-201)
radiation effects on, 20: 20183
reactions with hydrogen at high temperatures, 20: 20177(R) (BNL-929, pp 83-105)
reactions with steam at 1300 to 1600°F, 20: 19191 (ORNL-TM-1430)
thermal diffusion of boron in, 20: 20365

GRAPHITE (IMPREGNATED)
processing of spent, methods for, 20: 20183

GRAPHITE MODERATED REACTORS
neutron buckling in plutonium dioxide-uranium-dioxide fueled, (E), 20: 20198 (AEEW-R-464)
neutron buckling in plutonium and uranium dioxide fueled, (T), 20: 20199 (AEEW-R-466)
neutron multiplication factor in natural uranium, optimization of, 20: 20217

GRASS
fission product uptake by bristle, 20: 18906(T)
forage yield from estimation by beta attenuation, 20: 19119
iodine-131 deposition on forage, effects of meteorological conditions on, 20: 18941(R) (IDO-12047)

radiosensitivity of seeds of *Lolium perenne*, effects of water content on, 20: 18382
strontium-90 uptake by pasture, 20: 18232
GRAVITATION
coordinates in relativistic spherical hydrodynamics, retarded-time, 20: 19701
effect in origin of cosmic particles, 20: 19410
effects in quantum theory, (T), 20: 19602
Einstein vacuum field equations for spatially homogeneous, Riemann tensor for, 20: 19716
field equations with geodesic rays for, 20: 19710
invariance theorem in, relativity tests and properties of 6-dimensional Lorentz group L_6^+ from, 20: 19713
particle motion in, extended mass, (T), 20: 19698 (NP-15931)
radiation of, monopole, (T), 20: 19714
structure in fields of, space-time, 20: 19707
theory of, model for quantum, 20: 19279
theory of, multipole moments in Einstein, 20: 19709
GREENLAND
lead content in snow in, role of industrial lead pollutants in, 20: 18944 (NYO-3450-1, pp 213-15)
GROUND WATERS
location of, scintillation detector for, 20: 19092
solvent properties for calcite and carbon dioxide in caves, 20: 18631 (NYO-2266-1)
use of nuclear explosions in studies on, bibliography on, 20: 18855 (CEA-Bib-66)
GUINEA PIGS
gamma dosimetry in, using activation analysis, 20: 18975
photosensitivity of skin of, effects of furocoumarins on, 20: 18466
radiosensitivity of, effects of dithiosuccinic acid on, 20: 18483
radiosensitivity of, effects of oil and wax suspensions of serotonin on, 20: 18487
radiosensitivity of bone marrow of, effects of cyclohexanol succinate and lysozyme on, 20: 18494
use of skin of, as test system for radioprotective compounds, 20: 18485
GULF OF MEXICO
radioactivity of organisms and water in, from gamma emitters, 20: 18200 (NYO-3450-1, pp 109-29)
GUNDREMMINGEN POWER REACTOR
development, July 1–Sept. 30, 1965, 20: 20248(R) (TID-22707)

H

HAFNIUM
friction properties of, *in vacuo*, relation of lattice parameter to, 20: 19206 (N-65-17331
polishing of, electrolytic process for, 20: 19186(P)
separation from rare earths by ion exchange chromatography, 20: 18827
separation from zirconium by liquid-liquid partition of their thiocyanates, 20: 18828
HAFNIUM ALLOYS
Hf–Ta–W, analysis for alloying elements and impurities, comparison of results from 25 laboratories on T-111, 20: 18567 (NAB-217-M)
Hf–Zr, electrolytic polishing, 20: 19186(P)
HAFNIUM ISOTOPES Hf-166
energy levels of, high-spin rotational, (E/T), 20: 19953
HAFNIUM ISOTOPES Hf-168
energy levels of, high-spin rotational, (E/T), 20: 19953
HAFNIUM ISOTOPES Hf-170
energy levels of, high-spin rotational, (E/T), 20: 19953
HAFNIUM ISOTOPES Hf-172
energy levels of, high-spin rotational, (E/T), 20: 19953
HAFNIUM ISOTOPES Hf-178
energy levels of, high-spin rotational, (E/T), 20: 19953
HAFNIUM ISOTOPES Hf-180
energy level transitions in, parity mixing in, (E), 20: 19807 (ANL-7130, pp 333-6)
HAFNIUM ISOTOPES Hf-181
beta decay in hafnium oxide source, perturbations in gamma-gamma angular correlations in, (E), 20: 19863
HAFNIUM ISOTOPES Hf-182
nuclear data, 20: 19879
HAFNIUM ISOTOPES Hf-183
nuclear data, 20: 19880
HAFNIUM OXIDES
hafnium-181 beta decay in, perturbations in gamma-gamma angular correlation in, (E), 20: 19863
performance for insulating in-pile thermocouples, 20: 20185 (CONF-650204-9)
CaO–HfO_2, crystal structure and stability, 20: 18645
HAFNIUM SULFIDES
preparation and structure of HfS and Hf_2S, 20: 18678
HAFNIUM SYSTEMS
C–Hf–Ta, phase studies at 2050°C, 20: 19213 (N-65-21739)
HAFNIUM THIOCYANATES
separation from zirconium thiocyanate by solvent extraction using 4-methyl-2-pentanone, 20: 18828
HAIR
analysis of ungulate, neutron activation, 20: 18618
radiation effects on depigmentation of mouse, protective effects of melanogenetic substrates against x, 20: 18502
HALDEN BOILING REACTOR
coolant chemistry, 20: 20289(R) (HPR-65)
fuel element irradiation testing in, 20: 20289(R) (HPR-65)
operation, Oct.-Dec. 1965, 20: 20289(R) (HPR-65)
reactivity measurements in, 20: 20289(R) (HPR-65)
HALIDES
isotopic exchange between and organic halogen compounds, kinetics of, 20: 18701
HALLAM POWER REACTOR
fuel element fabrication for, safety criteria for uranium carbide, 20: 20228 (AI-Memo-8810(Rev.1))
HALOORGANIC COMPOUNDS
isotopic exchange between, and halides, kinetics of, 20: 18701
HAMBURG ELECTRON SYNCHROTRON
magnet power supplies for, flat topping of, 20: 19303 (PPAD-581D)
HAMSTERS
intestinal transport in, effects of heavy water and water on, 20: 18212
neoplasia induction in kidney-cell cultures from, by adenovirus LLE46, 20: 18197
radiation effects on, gamma, 20: 18291(R) (N-65-17058)
radiosensitivity of melanomas in, effects of cyclohexanolsuccinate on, 20: 18463
radiosensitivity of, effects of oil and wax suspensions of serotonin on, 20: 18487
HANDLING AND STORAGE
equipment for packaging radioactive wastes, 20: 20348 (RL-SA-60)
methods for, of plutonium materials at Rocky Flats, Colo., 20: 18948 (RFP-720)
HARWELL SYNCHROTRON
beam extraction system for, design of, 20: 19301 (NIRL-R-44)
beam injection system for, design of, 20: 19301 (NIRL-R-44)
design and operation of, 20: 19301 (NIRL-R-44)
magnet systems for, design of, 20: 19301 (NIRL-R-44)
vacuum system for, design of, 20: 19301 (NIRL-R-44)
HASTELLOY C
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
HASTELLOY X
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
HAYNES 25 ALLOY
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
HEAD
radiation effects on mouse and rat, pathological y, 20: 18376
scanning of human, performance of positrons in, 20: 18185(R) (BNL-928, pp 126-47)
HEALTH PHYSICS
evaluation and testing of glove boxes, standards for, 20: 18947 (RFP-343)
program at Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)
program at Puerto Rico Nuclear Center, 20: 20360(R) (PRNC-73)
program for radon laboratories, 20: 18956
program in New York City, 20: 18966
research programs on, AEC contractor, 20: 18198
HEART
beating of cultured cells of, effects of enzymes and ATP content on, 20: 18210(R) (UCLA-12-576, pp 15-25)
diseases of, relations of, with chromosomes, 20: 20360(R) (PRNC-73)
radiation effects on function of, β, fast-neutron, and x, 20: 18328
radiation effects on, following cesium-137 therapy for esophageal cancer, 20: 18346
radiation effects on arteries and muscle of rabbit, x, 20: 18456
strontium-90 retention in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
HEAT
cellular and protein resistance to, effects of heavy water on, 20: 18218(T)
effects on growth of irradiated wheat, 20: 18323
radioinduced in Earth's crust, effects of, on thermoelastic stresses, 20: 18899
HEAT EXCHANGERS (LIQUID-LIQUID)
development for helium liquefier, 20: 19730
fluid temperature transients between dual, (T), 20: 18873 (UCB-34P64-1)

response of dual system of, dynamic, (T), 20: 18873 (UCB-34P64-1)
HEAT-RESISTING ALLOYS
development for liquid-metal containment, 20: 20177(R) (BNL-929, pp 83-105)
HEAT TRANSFER
burnout in 19-rod bundles with subcooled water and fog, 20: 18860 (BNWL-206)
by liquid metals, boiling, 20: 18870(R) (SAN-409-28)
in air-cooled aluminum-foil porous matrices, using radiant heat source, 20: 18875
in boiling-water reactors, 20: 20263 (TID-22758)
in forced flow sub- and supercritical water loops, 20: 18862 (COO-1177-19)
in organic-cooled reactor fuel bundles, failure mechanisms in, (E), 20: 20189
in parallel rod arrays, with turbulent air flow, 20: 18876
in turbulent flow of near critical water, (E), 20: 18861 (COO-1177-18)
in turbulent flow in pipes, (T), 20: 18873 (UCB-34P64-1)
in two-phase flow, model for, (T), 20: 18863 (EURAEC-1360)
research programs on reactor-coolant, 20: 20183
HEAT TRANSFER SYSTEMS
design using circulating helium gas for nuclear scattering experiments, 20: 18877
hydrodynamics of, statistical methods for, 20: 18878
HEAVY WATER REACTORS
control system for Danish PHWR, regulation of, 20: 20245 (RISO-M-241)
coolant temperature monitor for, design of, 20: 20186 (DP-834)
criticality determination for gas-cooled power, computer program for, 20: 20267 (UJV-1046)
criticality determination for gas-cooled power, computer program for, 20: 20268 (UJV-1422)
fuel rods for, studies of single, 20: 20183
neutron kinetics parameters in, delayed and photo-, (E), 20: 20209 (TID-22730)
radioisotope production in RA, 20: 20340
shielding for KS-150, neutron flux in, 20: 20269 (UJV-1454/65)
HELIUM
density of rotating liquid, at phase transition temperature, 20: 19750
diffusion in PIG reflex discharge plasma of, anomalous, (E), 20: 20083
effects on absorption spectra of cesium, pressure, (E), 20: 19386
effects on metal surfaces immersed in liquid, microscope for examining, 20: 19732
electron density in plasma of, measurement using open cylindrical resonator, 20: 20072
electron reactions at 19.8 to 23.2 ev, excitation of n = 2 states in, (E), 20: 19388
electron scattering by, quasibound negative-ion ground states in, (E), 20: 19387
electron-beam motion in plasma of, microwave emission from, (E), 20: 20071
electron-ion recombination in plasma of, in spherical container, (E), 20: 20070
energy level transitions in, two-photon emission in singlet metastable, (T), 20: 19367
energy level transitions of metastable, Hartree-Fock approximation for two-quantum, 20: 19399
flow of superfluid, hydrodynamics of, (T), 20: 19273(R) (BNL-929, pp 3-43)
heat transfer in liquid II, classical and quantum-mechanical turbulence in, 20: 19760
heat transfer in liquid II, (T), 20: 19761
ion and light emission from plasma of, time dependence of, (E), 20: 19995(R) (AD-630123)
ionization by high-energy electrons, single and double, (T), 20: 19398
liquefaction of, apparatus for, 20: 19730
microwave emission from PIG reflex discharge plasma of, (E), 20: 20082
microwave scattering by turbulent plasma of, in magnetic fields, (E), 20: 20039
positron scattering by, cross sections and phase shifts for low-energy, (T), 20: 19381
proton elastic scattering at 0.3 to 200 ev, cross sections for, 20: 19365
quantum effects in liquid, observation methods for macroscopic, 20: 19733
sound propagation in afterglow plasma of, Tonks-Dattner resonance determination of, (E), 20: 20044
superfluid critical velocity of, effect of channel diameter and film thickness on, 20: 19755
theory of liquid II, in rotating annulus, 20: 19758
HELIUM IONS
reactions with calcium-40 and oxygen-16, analysis of, (E/T), 20: 20365
reactions with tungsten at 200 ev to 4 kev, diffusion of trapped gas following, 20: 20128
scattering by argon and neon at 10 to 600 ev, cross sections for elastic, (E), 20: 19392
HELIUM ISOTOPES He-3
deuteron reactions with, products from, (E), 20: 19273(R) (BNL-929, pp 3-43)
neutron cross sections of, spin dependence of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
neutron reactions, spin dependence of, (E/T), 20: 20365
nuclear paramagnetism at 0.92 to 2.9°K, (E), 20: 19756
photodisintegration at 8.06 and 9.17 Mev, cross sections for, 20: 19946
photon reactions (γ,dp) and (γ,n2p) with, cross sections for, (T), 20: 19964
proton elastic scattering at 660 Mev, mechanisms for, (E/T), 20: 19978
reactions (He-3,α) with boron-10 at 5.5 Mev, angular distributions from, (E), 20: 19907
reactions (He-3,γ) with carbon-13 at 1.0 to 3.5 Mev, differential cross sections and ground-state gamma yields from, (E), 20: 19908
reactions (He-3,2p) with helium-3 at 1.15 and 5.00 Mev, final-state proton–proton interactions in, (E/T), 20: 19500
scattering by calcium-40 at 65.3 Mev, angular distributions for elastic, (E), 20: 19916
thermal conductivity of liquid, 20: 19614 (N-65-17283)
He-3–He-4, helium-3 nuclear paramagnetism in, at 0.92 to 2.9°K, (E), 20: 19756
HELIUM ISOTOPES He-4
binding energy of, S-state, (T), 20: 19875
energy levels, (E/T), 20: 20365
energy levels, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
energy levels from lithium-6 ($\gamma,^{*}$,2p) reactions at 30-Mev, excited, (E), 20: 19912
energy of liquid and solid, at absolute zero, ground-state, (T), 20: 19616 (N-65-27121)
phase transformation near lambda point, alpha-gamma solid, (E), 20: 19759
photon reactions (γ,pt) and (γ,2n2p) with, cross sections for, (T), 20: 19964
proton elastic scattering at 660 Mev, cross sections for, (E), 20: 19977
proton elastic scattering at 660 Mev, mechanisms for, (E/T), 20: 19978
scattering by calcium-40 at 65.3 Mev, angular distributions for elastic, (E), 20: 19916
thermal capacity of bcc phase of, (E), 20: 19757
thermal conductivity of liquid, 20: 19614 (N-65-17283)
He-3–He-4, helium-3 nuclear paramagnetism in, at 0.92 to 2.9°K, (E), 20: 19756
HELIUM SYSTEMS
Ar–He–Ne, striation production in hollow-cathode plasma at, (E), 20: 20085
He–H, contraction of spheres of, physical conditions in, (T), 20: 19345
He–H, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
HEMATOPOIETIC SYSTEM
colony-forming cells of, radioinduced migration in mice, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on tumor formation in, 20: 18198
radiosensitivity of mouse, effects of bacterial toxins on, 20: 18425
radiosensitivity of, 20: 18519
HEMOLYSIS
radioinduced in erythrocytes *in vitro*, effects of iodoacetic acid and related compounds on x, 20: 18468
HEPARIN
effects on ion fluxes in muscles, 20: 18293 (NP-14898)
HEPTANE
air–heptane, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)
HETEROGENEOUS REACTORS
coolant kinetics of, research on water, 20: 20178(R) (STL-372-27)
neutron spectra in, measurement techniques for, 20: 19778(R) (GA-6824)
HEXANE
effects on radiolysis of solid deuterated cyclohexane, 20: 18733
effects on solvent extraction of iron from hydrochloric acid using bis(2-chloroethyl) ether, 20: 18571 (ORNL-TM-1420)
radiation effects on ion mobilities in, effects of carbon tetrachloride and tetrahydrofuran on, 20: 18724 (BNL-10012)
HIGH-ALTITUDE EXPLOSIONS
effects on radio waves, v-l-f perturbations from, 20: 19677
radionuclide fractionation in debris from, 20: 18912
HIGH ENERGY INJECTION DEVICES
development status of Alice, DCX 1, and DCX-2, 20: 20365
HISTAMINE
effects on ion fluxes in muscles, 20: 18293 (NP-14898)
radiosensitivity effects in mice, 20: 18473
HISTIDINE
labeling with tritium following radiolysis of ribonuclease, 20: 18749
synthesis by yeast, genetic control of, 20: 18194
HOLMIUM

effects on x-ray fluorescent spectrometric determination of yttrium, 20: 18611
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-n-hexylphosphine oxide), 20: 18599
HOLMIUM ALLOYS
Ge–Ho, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Ho, preparation and crystal structure of HoGe, 20: 19224
HOLMIUM ISOTOPES Ho-160
beta decay of, Auger electrons for, (E), 20: 19958
energy levels from erbium-160 decay, (E), 20: 19958
HOLMIUM SILICIDES
preparation and crystal structure of, 20: 19224
HOLMIUM SULFIDES
Cu_2S–Ho_2S_3, phase studies, 20: 18644
HOMOGENEOUS REACTORS
power density and transfer function in zero-power, 20: 20212
HORMONES
biochemistry of endocrine gland, 20: 18530
effects of plant, on ascites tumors, 20: 18426
HORSES
hair and subcutaneous tissue analysis by neutron activation, 20: 18618
HUMIDITY
radiosensitivity effects on Tribolium, x, 20: 18302
HYDRAZINE
heptafluorouranate(V), thermal decomposition of, analysis of products formed by, 20: 18627 (NIJS-R-459)
heptafluorouranate(V), preparation and properties of, 20: 18628 (NIJS-R-460)
HYDRAZINE HYDROFLUORIDE
reactions with uranium hexafluoride, formation of hydrazine hepta-fluorouranate(V) in, 20: 18628 (NIJS-R-460)
HYDRAZYL, DIPHENYLPICRYL-
effects on product yields from radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
HYDROAROMATIC COMPOUNDS
labeling with carbon-14, 20: 18710
HYDROCARBONS
radiolysis of deuterated gaseous, proton transfer reactions in gamma, 20: 18742
radiolysis of solid, ranges of interactions in, 20: 18733
yield from radiolysis of oleic acid, 20: 18210(R) (UCLA-12-576, pp 15-25)
HYDROCHLORIC ACID
separation of iron from, by solvent extraction using bis(2-chloroethyl) ether, 20: 18571 (ORNL-TM-1420)
HYDRODYNAMICS
coordinates in relativistic spherical, retarded-time, 20: 19701
equations in, for asymptotic behavior of classical Green function, 20: 19630
stability in boiling water reactors, models for, (E/T), 20: 18871 (STL-372-14(1))
HYDROFLUORIC ACID
reactions with plutonium oxide–uranium oxide, factors affecting, 20: 18824(R) (EURAEC-1536)
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
reactions with stainless steel, 20: 18824(R) (EURAEC-1536)
separation from gas streams, methods for, 20: 18824(R) (EURAEC-1536)
HF–N_2O_3, corrosive effects on Monel and nickel, 20: 20177(R) (BNL-929, pp 83-105)
HYDROFLUORIC ACID COMPLEXES
with anisole and boron trifluoride in nickel corrosion tests, ir spectral studies on, 20: 19135(R) (K-C-718)
HYDROGEN
diffusion in PIG reflex discharge plasma of, anomalous, (E), 20: 20083
effects on concrete moisture-content measurements by thermal neutron scattering, 20: 18610
effects on reactions of isopropylbenzene on gamma-irradiated alumina–silica system, 20: 18768
effects on tensile properties of niobium and tantalum alloys, 20: 19228
electron and ion densities in glow discharge plasma of, between coaxial dielectric cylinders, (T), 20: 20068
electron beam interactions with, plasma production during instability in, (E), 20: 20078
electron inelastic by, Born amplitudes for, (T), 20: 19382
electron radiative capture in plasma of, cross sections for, (T), 20: 20047
electron reactions with excited atoms of, high-energy excitation cross sections for, (T), 20: 19401
electron scattering by molecular, quasibound negative-ion ground states in, (E), 20: 19387
emission from sun, geomagnetic storm mechanism from theory of, 20: 19687
evolution on mercury electrode in acid solutions, effects of proton tunneling on, 20: 18648
ion cyclotron instabilities in plasma of, electrostatic character and wave structure of, (E), 20: 20028
ion exchange reactions with cesium, rubidium, and strontium on ferro-cyanide molybdate, kinetics of, 20: 18564 (EUR-2748.e)
ionization of atoms of, in low-pressure r-f discharge, (E), 20: 19617 (N-65-27393)
ionization of, Franck-Condon factors for, 20: 18664
ionization striation production in hollow-cathode plasma of, (E), 20: 20085
meson (μ^-) capture in liquid, (E/T), 20: 19374
microwave emission from PIG reflex discharge plasma of, (E), 20: 20082
motion in hydrogen-transition element systems, (E), 20: 20107 (EUR-2734.e)
neutron scattering by liquid, review on, (E), 20: 19799
production and properties of supersonic vacuum jets of, (E), 20: 19639
production in low-pressure discharge, effects of nitrogen, oxygen, and water on atomic, 20: 18663
production of atomic, by cyclotron resonance discharge, 20: 19403
proton reactions with, probability of electron capture in, (T), 20: 19384
radiation effects on evolution of, from sulfonic acid ion exchange resins, 20: 18728 (NIJS-R-458)
reactions of accelerated atomic, with DNA and thymine, 20: 18273
reactions with carbon-11 and ethylene, 20: 18716
reactions with carbon at 4.2°K, 20: 18667
reactions with graphite at high temperatures, 20: 20177(R) (BNL-928, pp 83-105)
reactions with organic compounds, ESR studies of, 20: 18295(R) (UCLA-12-576, pp 27-56)
reactions with uranium(IV-VI) oxides, formation of semiconducting phases in, 20: 18675
refractive index of liquid, at 20 to 31°K, (E), 20: 19727
scattering on rare gases, velocity dependence of total cross section for molecular, (E), 20: 19378
separation from deuterium and deuterium hydrides by ion exchange, effects of temperature on, 20: 18589
separation from tritium in evolution on mercury electrode, 20: 18648
sorption by beryllium oxide at 300 to 500°C, 20: 18688
spectra of, isotope effects on vibrational transition probabilities in, 20: 18639
spectral-line profiles of nitrogen and oxygen impurity ions in theta-pinch plasma of, (E), 20: 20061
surface tension of liquid, at 14 to 33°K, 20: 19613 (N-65-17282)
thermal conductivity of liquid, 20: 19614 (N-65-17283)
thermodynamic equilibrium of plasma of, deviations from, (T), 20: 20033
thermodynamic properties of, quantum mechanics of, (E/T), 20: 18656
transport properties of gaseous, at 10 to 300°K, 20: 18665
yields from gamma radiolysis of binary mixtures of methanol, pyridine, and water, 20: 18736
yields from gamma radiolysis of methanol, effects of catalysts on, 20: 18744
yields from gamma radiolysis of aqueous solutions of oxyanion salts at 77°K, 20: 18748
yields from gamma radiolysis of polypropylene, effects of nitrous oxide on, 20: 18770
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
yields of deuterium-labeled and normal, in radiolysis of deuterated mixtures of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
HYDROGEN ION CONCENTRATION
effects on anodic deposition of radioactive elements, 20: 18676
effects on carbon dioxide exchange in algae, 20: 18206(R) (N-65-16815)
effects on electrochemical reduction of aliphatic nitro compounds in organic solvents, 20: 18636(R) (TID-22725)
effects on radioprotection of barley seeds by carbonates and phosphates, 20: 18435
HYDROGEN IONS
concentration near satellites, proton-whistler determination of, (E), 20: 19669
electron photodetachment from negative, cross sections for, (T), 20: 20047
production of atomic, in low-pressure r-f discharges, (E), 20: 19617 (N-65-27393)
HYDROGEN ISOTOPES H-4
production of, review of attempts at, 20: 19982
HYDROGEN ISOTOPES H-5
production of, review of attempts at, 20: 19982
HYDROGEN PEROXIDES
effects on Neurospora, utilization of mutagenic, 20: 18347

labeling with oxygen-18, method for, 20: 18810
yields in gamma radiolysis of deaerated aqueous solutions of lithium, rubidium, and sodium sulfates, 20: 18782
yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
HYDROGEN SULFIDES
radiosensitivity effects on *Bacillus megaterium* spores, 20: 18434
HYDROGEN SYSTEMS
chlorotrifluoromethane–H, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
He–H, contraction of spheres of, physical conditions in, (T), 20: 19345
He–H, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
H–N, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
H–O, effects on yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
H–^{235}U, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
HYDROGEN TRITIDES
yields from reactions of recoil tritium with benzene, 20: 18814
HYDROLOGY
dispersion and movement in coastal and inshore waters in Cape Kennedy area, physical processes in, 20: 20359 (NYO-2973-1)
radioisotope uses in, 20: 19128
HYDROMAGNETIC WAVES
amplification in magnetosphere, (T), 20: 19666
propagation in nonuniform magnetosphere, coupling resonance for, (T), 20: 19692
properties of three-dimensional, in uniform cold plasma, (T), 20: 19693
HYDROXYL IONS
production of, by electron capture in water, (E), 20: 18557 (ORNL-TM-1409)
HYDROXYL RADICAL
absorption spectra, 20: 20365
abundance of interstellar, gas-kinetic exchange reactions for, (T), 20: 19339
effects on gamma-induced ferricytochrome C reduction, 20: 18773
yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
HYDROXYLAMINE
use in synthesizing oxygen-18-labeled hydrogen peroxide, 20: 18810
HYPERONS
decay amplitudes for, partially-conserved axial current hypothesis for nonleptonic, 20: 19574
decay of, p-wave nonleptonic and representation mixing in, (T), 20: 19537 (IC-66/26)
decay of, selection rules for leptonic, 20: 19436 (ANL-7130, pp 159-88)
HYPERONS (Λ)
interactions with protons at 40 to 250 Mev, effect of hard core on cross sections for, (T), 20: 19475
interactions with nucleons, unitary symmetry for structure of weak, 20: 19489
lifetime, (E), 20: 19485
magnetic moment, (T), 20: 19273(R) (BNL-929, pp 3-43)
magnetic moments of, in terms of meson (K) photoproduction amplitudes using current algebra, (T), 20: 19482
HYPERONS (Ω^-)
decay scheme, (E/T), 20: 20365
production of, research on, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
HYPERONS (Σ^-)
decay characteristics of, (E), 20: 19467
HYPERONS (Σ^0)
decay of, hyperon (Λ^0) polarization in Dalitz, (T), 20: 19427 (ANL-7130, pp 13-16)
HYPERONS (Σ^+)
decay characteristics of, (E), 20: 19467
magnetic moments of, in terms of meson (K) photoproduction amplitudes using current algebra, (T), 20: 19482
HYPERPLASIA
effects on radiocolloid uptake by lymph nodes in rabbits, 20: 18241
HYPOPHOSPHITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
HYPOSULFITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

I

ICE
radiation chemistry of single and polycrystalline, 20: 18190(R) (UCRL-16613)
radioinduced nucleation in supercooled water, crystal density of, 20: 19073
IGNEOUS ROCKS
age estimation of, in Colorado, 20: 18924(R) (NYO-1669-11)
age estimation of, in western Connecticut and New York, 20: 18924(R) (NYO-1669-11)
IMMUNE REACTIONS
effects on reticulo-endothelial functions in mice, 20: 18190(R) (UCRL-16613)
IMMUNITY
radiation effects on rabbit smallpox, x, 20: 18408
IN-PILE LOOPS
development for chemonuclear research, 20: 20177(R) (BNL-929, pp 83-105)
INCONEL X
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
INDEXES
to ORNL Master Analytical Manual, 1953 through 1965, 20: 18575 (TID-7015(Indexes)(Rev.3))
INDIA
waste processing techniques in, review of, 20: 20351
INDIAN OCEAN
carbon-14 content of deep waters of, 20: 18934
INDIUM
electric conductivity of intermediate state of superconducting, vortex-motion mechanism for, (E), 20: 19743
microwave reflection and transmission coefficients of thin superconducting films of, 20: 19772
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron elastic and inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
separation from rare earths by ion exchange chromatography, 20: 18827
INDIUM ALLOYS
Bi–In, bismuth-209 NMR in liquid, 20: 20157
Bi–In, indium-115 NMR in liquid, 20: 20157
Cd–In, electron band structure and superconductivity of, 20: 19764
Cd–In, indium-115 NMR in liquid, 20: 20157
Cd–In–Ag, reactivity worths in water-moderated uranium oxide cores, 20: 20210 (WCAP-3269-39)
Ce–In, crystal structure of Ce_3In, 20: 19226
In–Hg, indium-115 NMR in liquid, 20: 20157
In–Pb, indium-115 NMR in liquid, 20: 20157
In–Pb, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745
In–Pb, microwave surface resistance in copper-plated superconducting, intrinsic hysteresis in, (E/T), 20: 19752
In–Sn, indium-115 NMR in liquid, 20: 20157
In–Tl, indium-115 NMR in liquid, 20: 20157
INDIUM IONS
design of source of, 20: 19281
INDIUM ISOTOPES In-113
energy levels of, structure from isomeric transition in, (T), 20: 19970
INDIUM ISOTOPES In-114
energy level transition processes of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
preparation of isomeric, of high specific activity, 20: 19137
production of isomeric, in neutron activation of indium at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
INDIUM ISOTOPES In-115
energy levels of, structure from isomeric transition in, (T), 20: 19970
neutron absorption resonance integrals, 20: 20201(R) (ANL-7110, pp 311-401)
nuclear magnetic resonance in liquid binary alloys, 20: 20157
production of isomer of, generator for, 20: 19136
INDIUM ISOTOPES In-116
production in neutron reactions (n,p) with tin-116 at 14 Mev, cross sections for isomeric, (E), 20: 19939
INDIUM ISOTOPES In-118
decay of isomeric, (E), 20: 19939
production in neutron reactions (n,p) with tin-118 at 14 Mev, cross sections for isomeric, (E), 20: 19939
INDIUM ISOTOPES In-120
decay of isomeric, (E), 20: 19939
production in neutron reactions (n,p) with tin-120 at 14 Mev, cross sections for isomeric, (E), 20: 19939
INDOLE, 2-(2-AMINOETHYL)-
preparation of oil and wax suspensions of, 20: 18487
radiosensitivity effects of oil and wax suspensions of, in mammals, 20: 18487
INDOLE, 3-(2-AMINOETHYL)-5-METHOXY-
radiosensitivity effects in mice, x, 20: 18430
radiosensitivity effects on mice during simulated space flight, gamma, 20: 18443
5-INDOLOL, 3-(2-AMINOETHYL)-
effects on irradiated mice, delayed toxic, 20: 18488

effects on normal tissues and tumor growth, 20: 18475
radiation effects on content of, in rabbit blood, x, 20: 18257
radiosensitivity effects on mice, mechanisms for x, 20: 18431
radiosensitivity effects in mice, 20: 18473
radiosensitivity effects on rabbit eyes, 20: 18476
radiosensitivity effects in mice, 20: 18488
INDUSTRIAL HYGIENE
review of nuclear, 20: 20367
INFECTIONS
radiation effects on meat toxoplasma, y, 20: 19122
radioinduced buccal, 20: 18308
INFLAMMATION
radioinduced pulmonary, drug therapy of, 20: 18543
INFORMATION CENTERS
description of nuclear fuel technology, 20: 20220 (ORNL-TM-1358)
reactor physics constants, 20: 20201(R) (ANL-7110, pp 311-401)
INFORMATION RETRIEVAL SYSTEMS
description of nuclear fuel technology, 20: 20220 (ORNL-TM-1358)
INFRARED RADIATION
effects on alpha-induced luminescence of manganese-doped cadmium zinc sulfides, 20: 18738
INSECTS
radiation control of, in grain, 20: 19123
radiation control in stored food products, facilities and program for, 20: 19124
radiation effects on fertility of caterpillar, 20: 18329
radiation effects *Bombyx mori*, y, 20: 18345
radiation effects on mango seed weevil, gamma, 20: 18298(R) (UH-235P5-1, pp 39-46)
radiation effects on cane borer (*Diatraea saccharalis*), 20: 18198
radiosensitivity of Tribolium, x, 20: 18302
INSTRUMENTATION
bibliography on, for high-temperature control and measurement, 20: 19216 (NP-15388)
development and performance of, for particle physics measurements, 20: 19273(R) (BNL-929, pp 3-43)
development for reactors, 20: 20183
development for solar-thermionic power systems, 20: 19419 (N-65-24874)
development of biomedical, 20: 18988(R) (ORNL-929, pp 58-66)
development of servo control, for stochastic processes, 20: 20362 (SCL-DC-65-112)
properties of power reactor, review of, 20: 20246 (RISO-M-312)
INSTRUMENTS
book: *Decontamination and Deactivation Instruments*, in German, 20: 18979
performance of Gulliver III, for detecting extraterrestrial life, 20: 18187(R) (N-65-16497)
radium hazards from surplus military, evaluation of, 20: 18984
INSULIN
properties and synthesis of analogs of, 20: 18185(R) (BNL-929, pp 126-47)
INTERFEROMETERS
design for detection of plasma spectral line shifts, 20: 20042
use in extragalactic radio source position determination, (T), 20: 19348
INTERNATIONAL ATOMIC ENERGY AGENCY
regulations for transport of radioactive materials, 20: 18940 (EUR-2747.f)
INTESTINE
phosphorus absorption in dog, effects of high-frequency and ultrasonic vibrations on, 20: 18219
radiation effects on DNA synthesis in cells of, time intervals for fractionated-dose, 20: 18278
radiation effects on mitosis duration in epithelium of turtle, effects of temperature on gamma, 20: 18291(R) (N-65-17058)
radiation effects on, following radium therapy of cervical cancer combined with telecobalt or x rays, 20: 18309
radiation exposure of mouse, effects on distant chromosomes of x, 20: 18356
shielding of mouse, effects on radioinduced hematopoiesis, 20: 18432
transport in hamster, effects of heavy water and water on, 20: 18212
INULIN SPACE
radiation effects on, of muscles, y and x, 20: 18293 (NP-14898)
IODATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
IODINE
content in ratio with bromine and chlorine in aerosols, atmosphere, and rainwater in Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
effects on iodine-131 excretion by calves, 20: 18223
energy levels of, lifetimes and self-quenching cross sections of fluorescence from, (E), 20: 19360 (UCRL-16441)
iodine-131 exchange between, and 1-phenyl-2,3-dimethyl-4-iodopyrazolone, effects of nitro compounds on, 20: 18690
kinetics in gas cooled reactors, species interchange, (E), 20: 19222 (TRG-Report-954)
reactions with uranium(IV) iodide at 200, 300, and 400°C, 20: 18640
IODINE ISOTOPES I-125
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
IODINE ISOTOPES I-126
retention in gamma reactions (y,n) in potassium iodates, 20: 18726 (IS-T-74)
IODINE ISOTOPES I-127
Mössbauer isomer shifts in, in compounds, (E), 20: 20139
IODINE ISOTOPES I-129
energy levels of, structure from isomeric transition in, (T), 20: 19970
gamma emission in alkali iodide crystals, Debye-Waller factor and second-order Doppler shift for, (T), 20: 20150
Mössbauer isomer shifts in, in compounds, (E), 20: 20139
IODINE ISOTOPES I-130
diagnostic uses of, 20: 18198
IODINE ISOTOPES I-131
contamination from accidental release of, human and milk, 20: 18983
content in atmosphere, soil, and food in U. S., 1963 to 1965, 20: 18980
content in cow's milk, measure for moderating, 20: 18985
content in diet in U. S., 1961 through 1964, 20: 18920
content in environment, measurement by analysis of content in thyroid glands of cattle, 20: 18971
content in nose during thyroid radiotherapy, 20: 18512
content in thyroid glands of cattle, 20: 18971
content in thyroid gland of herbivorous and granivorous animals living on contaminated terrain, 20: 18211(R) (UCLA-12-576, pp 89-111)
deposition on vegetation, effects of meteorological conditions on, 20: 18941(R) (IDO-12047)
determination by autoradiographic measurement of half life using ring oven methods, 20: 18584
dosimetry of, at various source distances, 20: 19091
dosimetry of, equation for internal, 20: 18955
effects on animals and man, 20: 18198
effects on iodine metabolism and performance of dairy cows, 20: 18188(R) (ORO-635)
exchange between iodine and 1-phenyl-2,3-dimethyl-4-iodopyrazolone, effects of nitro compounds on, 20: 18690
excretion by calves, effects of sodium chloride on, 20: 18223
separation of free, in labeled rose bengal preparations, 20: 18815
uptake by children's thyroids from Italian milk, radiation dose from, 20: 18962
uptake by human thyroid, 20: 20360(R) (PRNC-73)
uptake by man, effects of food contamination on, 20: 18211(R) (UCLA-12-576, pp 88-111)
uptake by man, effects of environmental contamination on, 20: 18941(R) (IDO-12047)
uptake by milk and soils, 20: 18198
uptake by thyroid under normal conditions, computer program for determining, 20: 18514
use for visualization of lungs, 20: 18509(R) (UCLA-12-576, pp 61-80)
IODINE ISOTOPES I-132
dosimetry of, equation for internal, 20: 18955
production method for, 20: 20177(R) (BNL-929, pp 83-105)
IODINE ISOTOPES I-133
dosimetry of, equation for internal, 20: 18955
ION BEAMS
focusing device for, 20: 19013(P)
focusing mass spectrometer, inhomogeneous magnetic fields for, 20: 19163
interactions with plasma transversely to magnetic field, stability of, (T), 20: 20066
production and properties of mercury, using duoplasmatron, 20: 19004
production in sector-type electromagnetic isotope separator, 20: 19144
reactions with molecular beams at low energies, absolute cross sections for charge transfer, (E), 20: 19670
spectra of Van de Graaff, emission, (T), 20: 19402
trajectories in magnetic and electrostatic sector fields, fringing effects in, (T), 20: 19278
use in plasma diagnostics, 20: 20009 (N-65-22617)
use in solid-state physics, 20: 20121
ION EXCHANGE MATERIALS
diffusion of barium, calcium, and strontium in synthetic zeolites, tracer studies of kinetics of self-, 20: 18686
properties of Attapulgus, for polyphenyl purification, 20: 18625 (EUR-2646.e)
properties of ferrocyanide molybdate for use as, kinetic, 20: 18564 (EUR-2748.e)
properties of zirconium phosphate as, 20: 18841
sorptive properties for hydrogen isotopes, effects of temperature on, 20: 18589

sorptive properties of zeolite for ammonium and sodium ions in presence of barium, thermodynamics of, 20: 18629(R) (NP-15353)
ION SOURCES
design and performance of sputtering, 20: 19309
design and performance of high-temperature hollow-cathode, 20: 19002
design for polarized ions, 20: 20365
design of indium, 20: 19281
electronic equipment for, design of, 20: 19032(R) (N-65-23928)
ion emittance measurements for duoplasmatron, (E/T), 20: 19288 (BNL-10096)
performance for fast electromagnetic separations of radioisotopes, 20: 19143
performance for sector-type electromagnetic isotope separator, 20: 19144
performance of magnetron, 20: 19003
performance of mercury duoplasmatron, 20: 19004
performance of thermal, for electromagnetic separation of cesium isotopes, 20: 19142
properties of mono- and duo-plasmatron, 20: 19000
properties of mono-plasmatron, 20: 19001
use of multi-ion, in isotope separation, 20: 19157
IONIZATION CHAMBERS
development for detection and measurement of cosmic radiation in space, 20: 19029 (N-65-16933)
performance for neutron detection, 20: 19047 (UCRL-16595)
performance of, error statistics for, 20: 19053
stem effect in, effects of applied voltage on, 20: 19112
IONOSPHERE
bremsstrahlung x rays in auroral-zone D region of, energetic electron-precipitation determination from, (E), 20: 19672
charged particle precipitation in south auroral zone, correlation with geomagnetic index, (E), 20: 19686
cosmic noise absorption in auroral-zone D region of, electron precipitation determination from, (E), 20: 19672
cosmic noise absorption in auroral zone, mechanism for, (E), 20: 19681
diffusion in F region of, continuity equation for, 20: 19652
disturbances in, geomagnetic sudden commencement effects on traveling, (E), 20: 19655
electric currents in, extraterrestial effects on, 20: 19659
electrodynamics of, review of, 20: 19696
electron and ion temperatures in, 20: 19648
electron density and temperature in F-region of, (E), 20: 19643 (N-65-23662)
electron density distribution in equatorial F2 region of, (T), 20: 19653
electron density distribution in F2 layer of, power series for, 20: 19656
electron density in, sunspot activity correlations with, 20: 19647
electron density in F2 region of, solar flare effects on, 20: 19663
electron precipitation in auroral-zone, bremsstrahlung x-ray production from, (E), 20: 19671
electron precipitation in auroral-zone, radiowave broadbeam absorption correlation with, (E), 20: 19685
formation of, review of theory for, 20: 19695
geomagnetic field effects on F2-region equatorial anomaly, 20: 19658
heating of topside, photoelectron mechanism for nonlocal, (T), 20: 19651
height variations of F2 layer of, during geomagnetic bay disturbance, (E), 20: 19654
ionization of nocturnal D region of, 20: 19662
ionization transport in E region of, sporadic-E layer formation in equilibrium theory for, 20: 19649
plasma diagnostics using Langmuir probes, (E), 20: 20007 (N-65-22196)
radiation intensity in, sunspot activity correlations with uv and x, 20: 19647
IONS
accelerator design for, 20: 19320(P)
density in glow discharge hydrogen plasma between coaxial dielectric cylinders, (T), 20: 20068
distribution in plasma of vacuum spark, 20: 20025
energy loss in arc discharge plasma in magnetic fields, (T), 20: 20074
lifetimes of negative, (E/T), 20: 18557 (ORNL-TM-1409)
orbit stability in eccentric magnetic fields, (T), 20: 19306 (ZfK-PhA-2)
reactions of heavy, with crystal lattices, (E/T), 20: 20365
reactions with carbon at 0.1 to 0.9 Mev, stopping cross section for $6 \leq Z \leq 20$, 20: 19368
reactions with molecules, energy transfer in, 20: 18556(R) (BNL-929, pp 66-82)
sputtering on crystals at low energies, research progress on, 20: 19358(R) (N-65-17255)
temperature in ionosphere, 20: 19648
wave equations for, continuous spectrum of Schroedinger operators for, 20: 19364
IRIDIUM
diffusion in uranium carbide–zirconium carbide, 20: 19211(R) (N-65-21350)
diffusion in uranium carbide–zirconium carbide at 1800°C, 20: 19212(R) (N-65-21351)
IRIDIUM ISOTOPES Ir-182
nuclear data, 20: 19879
IRIDIUM ISOTOPES Ir-183
nuclear data, 20: 19880
IRIDIUM ISOTOPES Ir-184
nuclear data, 20: 19881
IRIDIUM ISOTOPES Ir-185
nuclear data, 20: 19882
IRIDIUM ISOTOPES Ir-188
energy levels of, half life of 55-kev, (E/T), 20: 19955
IRIDIUM ISOTOPES Ir-191
energy levels in, lifetime of excited, (E), 20: 19942
IRIDIUM ISOTOPES Ir-192
decay of, conversion x-ray lines from, (E), 20: 19915
production in Mol BR-2 reactor, 20: 19139
IRIDIUM ISOTOPES Ir-196
half life, 20: 20177(R) (BNL-929, pp 83-105)
IRON
analysis for cobalt and nickel by bremsstrahlung activation methods, 20: 18613
content and distribution in shallow marine environments, 20: 18895 (NYO-3450-1, pp 217-76)
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
creep properties of, effects of dynamic and static heat treatments on, 20: 19246
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
determination of, using triphenylarsine oxide, 20: 18607
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
effects on determination of moisture content of soils by neutron method, 20: 19118
neutron attenuation in, fast, (E/T), 20: 20092 (AE-220)
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
neutron magnetic scattering in, numerical analysis of, 20: 19785 (RISO-118)
neutron total cross section of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron total cross section at 4 to 12 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
proton elastic scattering at 156 to 300 Mev, differential cross sections and polarization from second-order multiple scattering theory, 20: 19933
radiation effects on, annealing of neutron, 20: 19267
radiolysis in solutions containing sulfuric acid, yields of products of, 20: 18745
radiolysis in sulfuric acid solutions, performance of, for low-level gamma dosimetry, 20: 18793
reactions with uranium nitride at 700 to 1000°C, 20: 19187 (BMI-1760)
separation from hydrochloric acid solutions by solvent extraction using bis(2-chloroethyl) ether, effects of hexane on, 20: 18571 (ORNL-TM-1420)
separation from rare earths by ion exchange chromatography, 20: 18827
thermodynamic properties at high temperatures and pressures, 20: 19217 (NP-15933)
viscosity of molten, effects of cerium and lanthanum on, 20: 19239
IRON ALLOYS
radiation effects on, neutron, 20: 20177(R) (BNL-929, pp 83-105)
Au–Fe, spectra at 4.2°K, Mössbauer hyperfine, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
Ce–Fe, viscosity of molten, 20: 19239
Fe–La, viscosity of molten, 20: 19239
Fe–Pd, structure of, magnetic, 20: 20365
Fe–Pu, corrosive effects on tantalum, 20: 20239(R) (LA-3482)
IRON CHLORIDES
electron exchange between (II) and (III), mechanisms of, 20: 18556(R) (BNL-929, pp 66-82)
IRON FERROCYANIDES
effects on excretion of cerium-137, 20: 18203(R) (LA-3432, pp 21-55)
use of Prussian Blue, in radiocesium body burden reduction, 20: 18438
IRON IONS
oxidation effects on uranium(IV) ions in sulfuric acid solutions, effects of temperature on, 20: 18693
radiation effects on content of, in rat liver DNA, 20: 18279
yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
IRON ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)
IRON ISOTOPES Fe-52
beta decay of, log ft values for, (T), 20: 19932
IRON ISOTOPES Fe-53

beta decay of, log ft values for, (T), 20: 19932
IRON ISOTOPES Fe-54
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
deuteron reactions (d,n) at 7.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EIR-119.e(Vol.2))
IRON ISOTOPES Fe-56
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
neutron capture at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
triton reactions (t,n) with, cobalt-58 levels from, 20: 20177(R) (BNL-929, pp 83-105)
IRON ISOTOPES Fe-57
Mössbauer spectrum of K-conversion line, (E), 20: 19847
IRON ISOTOPES Fe-58
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
proton reactions (p,n) with, cobalt-58 levels from, (E), 20: 19859
IRON ISOTOPES Fe-59
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
IRON NITRATES
sorption by glass surfaces, 20: 18846
IRON OXIDES
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
solubility in water, 20: 20365
IRON(III) OXIDES
preparation of kryptonates, by diffusion, 20: 18570(R) (NYO-2757-5)
IRON SELENIDES
magnetic structure of, from polarized neutron scattering, 20: 20335
IRON SILICATES
magnetic properties of, determination of, by neutron diffraction, 20: 20360(R) (PRNC-73)
IRON SULFATES
use in radiation dosimetry in trabecular bones, 20: 18953
IRON(II) SULFATES
transition temperature of cobalt or zinc in, 20: 18677
IRON SYSTEMS
Fe–Mo–N, preparation of kryptonates of Moly-Perma-Foil by diffusion, 20: 18570(R) (NYO-2757-5)
Fe–UO_2, radiation effects on pellets of, 20: 20177(R) (BNL-929, pp 83-105)
IRON TELLURIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148
IRRADIATION FACILITIES
calibration of Mark IV, at University of Hawaii, 20: 18950(R) (UH-235P5-1, pp 26-38)
contamination in, dosimetry of, 20: 18957
design for photoinduced reactions, 20: 20177(R) (BNL-929, pp 83-105)
sample-holding device for, design of, 20: 18858(P)
survey of γ, for plants, 20: 18400
IRRADIATION TECHNIQUES
design for exposing one uterine horn, 20: 18404
ISOFLAVONE
5,7-dihydroxy, radiosensitivity effects in mice, 20: 18489
ISOLEUCINE
labeling with tritium following radiolysis of ribonuclease, 20: 18749
ISOTOPE EFFECTS
in chemical reaction rates, research on, 20: 20365
of carbon-13 on triphenylmethylchloride ionization, 20: 18556(R) (BNL-929, pp 66-82)
of deuterium on thermal decomposition of cyclobutane, 20: 18713
of deuterium on uv-induced fluorescence of terbium complexes in aqueous solution, 20: 18683
on critical solution temperature of phenols in heavy water, 20: 18720
on ESR spectra of irradiated ammonium sulfates, 20: 18761
on ionic solvation, 20: 18643
on reduction of selenates and selenites, 20: 18642
on surface phenomena in gaseous diffusion, 20: 19138
on vibrational transition probabilities of molecules, 20: 18639
quantum statistical mechanics of, on internal energy and surface tension, (E/T), 20: 18656
ISOTOPE SEPARATION METHODS
development for stable isotopes, 20: 19120
electromagnetic, conference on, 20: 19141
operation and performance of engineering-scale test unit for boron, using anisole–boron trifluoride, 20: 19135(R) (K-C-718)
ISOTOPES
production of special, summary for BNL, 20: 20177(R) (BNL-929, pp 83-105)
separation of, conference on electromagnetic, 20: 19141
separation using mass spectrometers, effect of gas scattering on contamination of, 20: 19146
ISOTOPIC EXCHANGE
between elementary iodine and 1-phenyl-2,3-dimethyl-4-iodopyrazolone, effects of nitro compounds on, 20: 18690
between halides and organic halogen compounds, kinetics of, 20: 18701
equilibrium in two-compartment systems, model for, 20: 18651
equipment design for boron isotope, in anisole–boron trifluoride, 20: 19135(R) (K-C-718)
use for eliminating cobalt-60 and zinc-65 in rats, 20: 18216
ITALY
iodine-131 in milk from, radiation dose to thyroid from, 20: 18962
radioactivity from cesium-137 and strontium-90 in sea water near Genoa, 20: 18592
sodium-22 content in rain water at Livourne, 20: 18907

J

JAPAN
radiation monitoring in, program for fallout, 20: 18921
JEEP REACTOR
research program for, nuclear and solid state physics, 20: 20332
JETS
evolution in fluid flow in transverse magnetic field, (E), 20: 19625
production and properties of supersonic vacuum hydrogen, (E), 20: 19639
JOURNAL BEARINGS
properties of liquid–metal lubricated, (T), 20: 18853(R) (SWRI-1228-8-20)

K

KERATINS
radioinduced in squamous cell carcinomas, gamma and x, 20: 18255
KETONES
radiosensitivity effects on plant seeds, β, 20: 18442
KIDNEYS
function tests on, radioisotope, 20: 18509(R) (UCLA-12-576, pp 61-80)
neoplasia induction in cultured hamster, by adenovirus LLE46, 20: 18197
radiation effects on concentration of oxidized and reduced TPN in rat, x, 20: 18343
radiation effects on uptake of phosphorus-32 by, effects of cyclohexane and synkavite on, 20: 18379
radiation effects on, 20: 18198
radiation effects on rat, effects of age on x, 20: 18284 (AD-629512)
radiodiagnosis of diseases of, 20: 18509(R) (UCLA-12-576, pp 61-80)
strontium-90 retention in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
KRYPTON
effects on radiolysis of deuterated hydrocarbons in presence of hydrogen, proton-transfer, 20: 18742
electron distribution in, solution of Thomas-Fermi-Dirac equation for, 20: 19366
lithium-7 reactions with, Massey-Mohr total elastic cross sections for, (E/T), 20: 19872
radiation effects on trapping of, on uranium carbide surfaces, 20: 19255 (EUR-2749.e)
separation from xenon by gas chromatography, 20: 18825 (KFK-365)
sorption by calcium fluoride and gold surfaces during evaporation and condensation, 20: 19255 (EUR-2749.e)
sorption in reactor dehydrator unit, tracer technique for measuring dynamic and static, 20: 18626 (GA-6865)
KRYPTON COMPOUNDS
preparation and properties of, review on, 20: 18623 (CEA-Bib-58)
KRYPTON FLUORIDES
radioinduced production of, 20: 20177(R) (BNL-929, pp 83-105)
KRYPTON IONS
reactions with platinum at 9 kev, diffusion theory for depth distributions from, 20: 20126
sputtering on oriented gold foils at 30, 50, and 100 kev, 20: 19372
KRYPTON ISOTOPES
separation and collection in mass spectrometers, tracer technique for study of, 20: 19150
KRYPTON ISOTOPES Kr-80
preparation by neutron irradiation of aluminum bromide, 20: 18731
KRYPTON ISOTOPES Kr-82
preparation by neutron irradiation of aluminum bromide, 20: 18731
KRYPTON ISOTOPES Kr-85
distribution with depth in ion-bombarded tantalum foils, 20: 18570(R) (NYO-2757-5)

energy levels of, structure from isomeric transition in, (T), 20: 19970
ranges in gold single crystals at 70 kev, (E), 20: 20134
tracer use for measuring sorption isotherms for coolant in HTGR, 20: 18626 (GA-6865)
KRYPTON ISOTOPES Kr-90
decay properties of, 20: 18825 (KFK-365)
separation in fission of uranyl stearate using on-line isotope separator, 20: 19887
KRYPTON ISOTOPES Kr-91
separation in fission of uranyl stearate using on-line isotope separator, 20: 19887
KRYPTONATES
preparation, properties, and uses of, 20: 18570(R) (NYO-2757-5)

L

LABORATORIES
design of, with low-level contamination for trace metal analysis in sea water, 20: 18576(R) (TID-22660)
radioactive contamination in, for trace metal analysis, 20: 18576(R) (TID-22660)
water circuit at Casaccia, dynamic analysis of, 20: 18878
LABORATORY EQUIPMENT
description of, for use at research reactors, 20: 20328
design and performance of, for activation analysis, 20: 18616
LACTATES
radiosensitivity effects on lactate dehydrogenase, uv and x, 20: 18451
LACTIC ACID, 2-METHYL-
use as complexing agent in electrophoretic separations of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
LAMINATES
gamma dose rate behind, computer program for, 20: 20095 (ORNL-3805)
LANTHANUM
determination by conductometric titration using potassium chromate, effects of ethanol on, 20: 18606
determination in nitrate solutions by conductometric titration using sodium tungstate, 20: 18608
determination in uranium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
effects on recrystallization of magnesium, 20: 19240
effects on viscosity of molten iron, 20: 19239
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
LANTHANUM ALLOYS
Fe–La, viscosity of molten, 20: 19239
Ge–La, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–La, preparation and crystal structure of LaGe, 20: 19224
La–Mg, crystallization, 20: 19240
LANTHANUM ALUMINATES
crystal structure of, 20: 19227
LANTHANUM BORIDES
thermionic emission from rhenium cathodes coated with, 20: 19229
LANTHANUM BROMIDES
electron paramagnetic resonance spectra of gadolinium-doped, 20: 18668
LANTHANUM CHLORIDES
cerium ion pairs electric quadrupole-quadrupole interaction in crystals of, (E), 20: 20154
LANTHANUM FLUORIDES
fluorine spin-spin relaxation in, at 100 to 560°C, (E), 20: 20149
LANTHANUM ISOTOPES La-140
orientation in neodymium ethylsulfate and cerium magnesium nitrate, coupling constants from, (E), 20: 20146
LANTHANUM SILICIDES
preparation and crystal structure of, 20: 19224
LANTHANUM SULFATES
electron paramagnetic resonance spectra of gadolinium-doped, 20: 18668
LARVAE
radiation effects on caterpillar, 20: 18329
radiosensitivity of Tribolium, x, 20: 18302
LARYNX
radiation effects on tissues of, γ, 20: 18311
LEAD
content in carbonatites, age estimation from, 20: 18924(R) (NYO-1669-11)
content in Greenland snows, role of industrial lead pollutants in, 20: 18944 (NYO-3450-1, pp 213-15)
content in zircons, age estimations from, 20: 18924(R) (NYO-1669-11)
determination in antimony–tin alloys using beta back scattering, 20: 18587
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
effects on induced superconducting energy gap of silver films, tunneling measurement of, 20: 19754
electric conductivity of intermediate state of superconducting, vortex-motion mechanism for, (E), 20: 19743
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, 20: 19395
electron tunneling in superconducting aluminum junctions with, structure from recombination effects on, (E), 20: 19744
electron tunneling in superconducting junctions of, magnetic field dependence of $2\Delta/n$ structure in, (E), 20: 19739
energy levels in, hyperfine structure and lifetime of, 20: 19379
energy levels in, lifetime of excited, 20: 19380
energy levels in, measurement of width of, (E/T), 20: 19948
magnetic hysteresis loops in superconducting, intrinsic properties of, (E), 20: 19741
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron elastic scattering at 84 to 350 Mev, differential cross sections from second-order multiple scattering theory, 20: 19933
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
proton reactions at 2.9 to 28 Bev, yields from, 20: 18556(R) (BNL-929, pp 66-82)
proton reactions at 0.5 to 2 Bev, neutrons from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
sputtering by argon ions at 20 kev, transparency model for, (E), 20: 19371
superconducting transitions in films of, anomalies and surface effects in resistive, (E), 20: 19749
ultrasonic attenuation in superconducting, anomalies of, (E), 20: 19766
LEAD ALLOYS
Bi–Cd–Pb–Sn, preparation of kryptonates of Wood's metal by diffusion, 20: 18570(R) (NYO-2757-5)
Bi–Pb, magnetic hysteresis loops in superconducting, (E), 20: 19741
Bi–Pb, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745
Bi–Pb, power losses in superconducting eutectic, surface nature of a-c, (E), 20: 19742
In–Pb, indium-115 NMR in liquid, 20: 20157
In–Pb, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745
In–Pb, microwave surface resistance in copper-plated superconducting, intrinsic hysteresis in, (E/T), 20: 19752
Pb–Na, preparation of kryptonates of, by diffusion, 20: 18570(R) (NYO-2757-5)
Pb–Th, thermodynamic properties of intermetallic compounds in, vapor pressure studies of, 20: 19244
LEAD BORATE GLASS
nuclear magnetic resonance studies on, 20: 19256(R) (NYO-2024-9)
radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
LEAD FLUORIDES
PbF_2–PbO, properties for use in preparation of rare earth chromites from fluxed melts, 20: 18654
LEAD IONS
potentials of divalent, half-wave, 20: 20177(R) (BNL-929, pp 83-105)
LEAD ISOTOPES
abundance in lead ores, model ages from measurement of, 20: 18928
composition in Baltic and Canadian Shield regions, geochemical significance of, 20: 18894 (NYO-3450-1, pp 169-84)
composition in carbonatites, 20: 18924(R) (NYO-1669-11)
separation in Karlsruhe mass spectrometer, contamination and resolution in, 20: 19147
LEAD ISOTOPES Pb-205
production of isomeric, in neutron activation of lead at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
LEAD ISOTOPES Pb-206
neutron total cross section of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
production of isomeric, in neutron activation of lead at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
LEAD ISOTOPES Pb-207
energy level transitions in, probabilities of E2, (T), 20: 19976
energy levels of, g-factor and lifetime of, (E), 20: 19846
production of isomeric, in neutron activation of lead at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
LEAD ISOTOPES Pb-208
carbon-12 reactions at 45.5 to 60.2 Mev, octupole Coulomb excitation in, (E), 20: 19894
electric charge of recoil atomic, from polonium-212 alpha decay, (E), 20: 19867
neutron total cross section of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
LEAD ISOTOPES Pb-210
content in cigarettes, 20: 18965

use for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
LEAD ISOTOPES Pb-212
alpha decay energy of, effect of shell structure on, (T), 20: 19848
deposition on platinum anode, effects of hydrogen ion concentration on, 20: 18676
LEAD ISOTOPES Pb-214
alpha decay energy of, effect of shell structure on, (T), 20: 19848
LEAD ISOTOPES Pb-216
alpha decay energy of, effect of shell structure on, (T), 20: 19848
LEAD NITRATES
sorption by glass surfaces, 20: 18846
LEAD ORES
deposition of, mechanism of, 20: 18894 (NYO-3450-1, pp 169-84)
LEAD OXIDES
B_2O_3–PbO, properties for use in preparation of rare earth chromites from fluxed melts, 20: 18654
PbF_2–PbO, properties for use in preparation of rare earth chromites from fluxed melts, 20: 18654
LEAD SILICATES
radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
LEAD ZIRCONIUM TITANATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
LEAVES
growth of Phaseolus, effects of rare earths on, 20: 18237
radiation effects on plant, solar and uv, 20: 18391
radiation effects on Xanthium combined solar and uv, 20: 18391
strontium-90 content in plant, 20: 18906(T)
LECTURES
book: *Strong Interactions and High Energy Physics*, 20: 19592
book: *Symmetry Groups in Nuclear and Particle Physics*, 20: 19591
LEUCINE
biosynthesis in Neurospora, genetic regulation of enzymes for, 20: 18196
LEUKEMIA
incidence in radiation-treated cancer cases, 20: 20360(R) (PRNC-73)
induction in mice, effects of bone marrow injections on urethan, 20: 18191
induction in mice, effects of thymectomy and subsequent thymus implantation on urethan, 20: 18192
radioinduced in germfree mice, x, 20: 18371
radioinduced in mice, mechanism for, 20: 18317
radioinduced in mice, viruses in, 20: 18198
radioinduced mouse virus, effects of injected, on thymus tumor incidence, 20: 18193
LEUKOCYTES
cytogenetic analysis of human, 20: 18307
radiation effects on mouse, β, 20: 18353
radiation effects on incidence of binucleated, 20: 18399
radiation effects on mouse, protective effects of 5-BUdR, MEA, and combined 5BUdR and MEA against x, 20: 18498
radiation effects of cathepsin activity in human, after cancer therapy, 20: 18244 (NIJS-R-467)
radiation effects on cell nuclei and enzymes in rat, effects of B vitamins on beta, 20: 18499
radioinduced abnormalities in chromosomes of human, 20: 18307
use in test for radioinduced pathological conditions, statistical reliability of, 20: 18394
LEUKOPENIA
effects of cysteamine on, in rats, 20: 18504
radioinduced in rats, effects of cyclophosphamide and radioprotective compounds on, 20: 18504
radiotherapy of, dosimetry of phosphorus-32 in, 20: 18544
LIDO
operation and maintenance of, problems in, 20: 20323
LIGHT
absorption by neutral gases, nonlinear, (E/T), 20: 19628
effects on colorless and pigmented bacteria, lethal, 20: 18361
effects on electric charge of spinach chloroplasts, 20: 18190(R) (UCRL-16613)
effects on maize endosperm, mutagenic, 20: 18392
radiosensitivity effects on leaves, solar and uv, 20: 18391
LIGHTNING
electron production from, 20: 19412
LIMBS
radiation exposure of mouse, effects on distant chromosomes of x, 20: 18356
LIMESTONE
rock matrix effect in, theory of neutron logging for, 20: 18932
LINEAR ACCELERATORS
beam focusing in, method of numerical study for alternate-phase, 20: 19311
development and operation of Brookhaven, 20: 19285(R) (BNL-929, pp 44-57)
performance of 1.5-Mev electron, for injection into electron microscope, (E), 20: 19308
LIPIDS
metabolism in chickens, effects of enzymes and estrogens on, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiation effects on metabolism of, in cotton seedlings, γ, 20: 18374
radiation effects on metabolism of, in rabbits and rats, x, 20: 18375
radiation effects on formation of myelin, in rat brain, 20: 18295(R) (UCLA-12-576, pp 27-56)
LIQUID METAL COOLED REACTORS
cooling system for sodium, conceptual design of valves for, 20: 20184 (ACNP-65579)
cooling system technology, 20: 20237 (EURFNR-42F)
LIQUIDS
kinetics and structure of, neutron spectroscopy for determining, 20: 20164
kinetics of, gamma and neutron scattering for studying, 20: 19620
neutron scattering in, thermal, (T), 20: 19793
neutron scattering by, thermal, (T), 20: 19798
neutron scattering by, review on, (E), 20: 19799
particle motion in nonuniform temperature fields, properties of, (T), 20: 18868 (NYO-2930-5)
positron reactions with, review of properties from, 20: 19460
structure of, interatomic forces in, (T), 20: 19621
LITHIUM
elasticity of, at 10 to 300°K, Young's modulus for, 20: 19221 (TID-21670)
Fermi surface of, from positron annihilation data, (E), 20: 20169
lithium-7 NMR knight shift in metallic, (E), 20: 20151
pumps for liquid, 20: 18857
reactions with metal surfaces at 20 to 60 kev, secondary electron emission in, (E), 20: 19363
reactions with radioinduced defects in silicon, 20: 19102(R) (N-65-19693)
LITHIUM ALLOYS
Al–Li, radioinduced tritium for bubbles in, behavior of neutron, (E), 20: 19265
LITHIUM BROMIDES
effects on spectra of uranium(III), 20: 18653
LITHIUM CHLORIDES
diffusion of tritium from irradiated, 20: 18763
effects on spectra of uranium(III), 20: 18653
Li–LiCl, interfacial tension at 618 to 844°C, use of maximum bubble pressure method for measuring, 20: 18624 (CU-2660-24)
LITHIUM FLUORIDES
preparation of single crystals, 20: 20365
LITHIUM HYDRIDES
reactions with aluminum, thermodynamics of, 20: 20177(R) (BNL-929, pp 83-105)
LITHIUM HYDROXIDES
spectra of, infrared, 20: 18556(R) (BNL-929, pp 66-82)
LITHIUM IODIDES
iodine-129 gamma emission in crystals of, Debye-Waller factor and second order Doppler shift for, (T), 20: 20150
LITHIUM ISOTOPES Li-6
alpha reactions (α,γ) with, level transition strengths from, (E), 20: 19911
effects on α- and β-transition in lithium sulfate, zone-refining determination of, 20: 19248
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
meson (π^+) reactions $(\pi^+,2p)$ 30-Mev, excited states from, (E), 20: 19912
neutron capture cross section, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron reactions (n,α) with, tritium production in, 20: 18763
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
reactions with xenon, Massey-Mohr total elastic cross sections for, (E/T), 20: 19872
use in neutron capture therapy, 20: 18507 (BNL-10009)
LITHIUM ISOTOPES Li-7
effects on α- and β-transition in lithium sulfate, zone-refining determination of, 20: 19248
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
nuclear magnetic resonance lithium metal, knight shift in, (E), 20: 20151
photon reactions with field of, nuclear magnetic effects on pair production in, (T), 20: 19968
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
reactions with krypton, Massey-Mohr for total elastic cross sections for, (E/T), 20: 19872
LITHIUM ISOTOPES Li-8
detection in proton reactions with carbon using on-line mass spectrometer, 20: 19886

LITHIUM ISOTOPES Li-9
detection in proton reactions with carbon using on-line mass spectrometer, 20: 19886
production by proton reactions with target masses $20 \leq A \leq 240$, cross sections for, 20: 18556(R) (BNL-929, pp 66-82)
LITHIUM NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
effects on solvent distribution of actinide and lanthanide ions in dodecylamine–nitric acid–trioctylphosphine oxide systems, 20: 18561 (EUR-2635.d)
LITHIUM OXIDES
B_2O_3–Li_2O, radioinduced defects in, ESR spectra of gamma, 20: 19156(R) (NYO-2024-9)
LITHIUM SULFATES
phase transitions in, isotope effects on α- to β-, 20: 19248
radiolysis of deaerated aqueous solutions of, cation polarization and hydrogen peroxide formation in gamma, 20: 18782
LITHIUM SYSTEMS
Li–LiCl, interfacial tension at 618 to 844°C, use of maximum bubble pressure method for measuring, 20: 18624 (CU-2660-24)
LIVER
analysis of tissues of, by activation methods, Szilard-Chalmers effect in, 20: 18583
cholesterol and sodium octanoate oxidation by mitochondria in rat liver, effects of water-d_2 on, 20: 18217
radiation effects on concentration of oxidized and reduced TPN in rat, x, 20: 18343
radiation effects on uptake of phosphorus-32 by, effects of cyclohexane and synkavite on, 20: 18379
radiation effects on nitrogen metabolism in frog, effects of splenectomy on gamma, 20: 18207 (NIJS-R-473)
radiation effects on DNA in rat, x, 20: 18260
radiation effects on DNA synthesis in cells of, time intervals for fractionated-dose, 20: 18278
radiation effects on DNA activation of catalase in, 20: 18279
radiation effects of uptake of carbon-14-labeled orotic acid by RNA in rat, x, 20: 18263
radioisotope scanning in human, collimators for, 20: 19051
radiosensitivity of, effects of cysteamine on rat, 20: 18457
regeneration of rat, molecular mechanisms for, 20: 18263
strontium-90 retention in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
zinc metabolism in cirrhotic and normal, tracer study, 20: 18222
LOOPS
design of high-pressure, for subcooled boiling investigations, 20: 18872(R) (STL-372-27, pp 13-21)
heat transfer in sub- and supercritical water, 20: 18862 (COO-1177-19)
LOS ALAMOS AREA (N. MEX.)
environs monitoring, 1964, 20: 18972
LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENTS
coolant for FRCTF, impurity removal from sodium, 20: 20239(R) (LA-3482)
development of FRCTF, 20: 20239(R) (LA-3482)
LOS ALAMOS OMEGA WEST REACTOR
fuel testing in, plutonium, 20: 20239(R) (LA-3482)
LOS ALAMOS TURRET REACTOR
development, 20: 20239(R) (LA-3482)
LUBRICANTS
bibliography on solid, 20: 19215 (NASA-SP-5037)
development for material pairs in sliding couple at ultrahigh vacuum and high temperature, 20: 18891
LUMINESCENT MATERIALS
preparation of self-, process for, 20: 18797(P)
LUNGS
plutonium-239 content in, measurement using proportional detectors, 20: 18186(R) (LA-3432, pp 102-29)
radiation dose to human, from cigarette smoke, 20: 18965
radiation effects on, following cesium-137 therapy for esophageal cancer, 20: 18346
radiation effects on, following therapy for thoracic malignancy, 20: 18305
radiodiagnosis of diseases of, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiography of, contrast media for, 20: 18517
strontium-90 retention in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
visualization of, tracer method for, 20: 18509(R) (UCLA-12-576, pp 61-80)
LUTETIUM
preparation of purified, 20: 20365
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
LUTETIUM ALLOYS
Ge–Lu, crystal structure of, at or near equiatomic proportions, 20: 19225
LUTETIUM ISOTOPES Lu-177
energy levels of, half life of 120-kev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
orientation in neodymium ethyl sulfate, quadrupole coupling constants from, (E), 20: 20146
LUTETIUM OXIDES
$LuO_{1.5}$–ZrO_2, electric conductivity of, 20: 19243
LUTETIUM SULFIDES
Cu_2S–Lu_2S_3, phase studies, 20: 18644
LYMPH CELLS
radiation effects on content of, in peritoneal cavity of mice, x, 20: 18285 (AD-630103)
LYMPH SYSTEM
radiation effects of incidence and latency of sarcomas in mouse, x, 20: 18317
radiation effects on gold-198 uptake by nodes in dog, 20: 18306
radioinduced tumors in mouse, etiology of x, 20: 18359
uptake of radiocolloids by nodes of rabbit, effects of pretreatment with Freund adjuvant on, 20: 18241
LYSINE
hydroxy-, effects on collagen properties, 20: 18185(R) (BNL-929, pp 126-47)
labeling with tritium following radiolysis of ribonuclease, 20: 18749
LYSOZYME
effects on toxicity of cyclohexanol succinate in rabbit bone marrow, 20: 18470
radiosensitivity effects on bone marrow of guinea pigs and rabbits, 20: 18494

M

MACHINE TOOLS
operation of, uses of radioisotopes in controlling, 20: 19128
MAGNESIUM
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
crystallization of, effects of cadmium, lanthanum, and tin on, 20: 19240
electron reactions with, ionization cross sections for, (T), 20: 19400
ionization equilibria in sun, (T), 20: 19338
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron total cross section at 4 to 12 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
proton reactions with, ionization cross sections for, (T), 20: 19400
x-ray emission spectra from solar, isothermal quiet-corona model for line intensities in soft, 20: 19338
MAGNESIUM ALLOYS
Cd–Mg, crystallization, 20: 19240
La–Mg, crystallization, 20: 19240
Mg–Ag, lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
Mg–Sn, crystallization, 20: 19240
MAGNESIUM CARBONATES
$CaCO_3$–$MgCO_3$, precipitation with magnesium from aqueous solutions at high temperatures, 20: 18631 (NYO-2266-1)
MAGNESIUM CERIUM NITRATES
rare earth ion orientation in, quadrupole coupling constants from, (E), 20: 20146
MAGNESIUM CHLORIDES
positron annihilation in, origin of second lifetime component from, (E), 20: 19486
separation of americium and rare earths from, by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
MAGNESIUM COMPLEXES
with 2,6-pyridinedicarboxylic acid, ion exchange properties of, 20: 18685
MAGNESIUM IONS
precipitation with calcite and calcium carbonate–magnesium carbonate system from aqueous solutions, 20: 18631 (NYO-2266-1)
MAGNESIUM ISOTOPES
content in natural samples, ratio variation in, (E), 20: 18908
MAGNESIUM ISOTOPES Mg-24
deuteron reactions (d,n) at 7.0 to 10.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
energy levels, (T), 20: 19984
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
MAGNESIUM ISOTOPES Mg-25
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)
MAGNESIUM ISOTOPES Mg-26
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)
MAGNESIUM ISOTOPES Mg-27

separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583

MAGNESIUM LANTHANUM NITRATES

proton dynamic polarization in (Nd, La)$_2$Mg$_3$(NO$_3$)$_{12}$ · 24H$_2$O, 20: 20166

MAGNESIUM NEODYMIUM NITRATES

proton dynamic polarization in (Nd,La)$_2$Mg$_3$(NO$_3$)$_{12}$ · 24H$_2$O, 20: 20166

MAGNESIUM NITRATES

analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)

MAGNESIUM OXIDES

performance as gaseous core reactor tube, 20: 20301 (NP-15906)

radiation effects on oxygen chemisorption by, fast-neutron and gamma, 20: 18787

MgO–W, development of oxidation-resistant, 20: 19193

MAGNESIUM SULFATES

transition temperature of cobalt or zinc in, 20: 18677

MAGNESIUM SYSTEMS

Al–Mg–Si, fabrication of cylinders of Anticorodal, using magnetic fields, 20: 19199 (RT/EL-(65)9)

MAGNET COILS

cooling system for superconducting, design of cryostat for, 20: 19731

design of 30 kG superconducting, 20: 19736

power transfers from r-f, to ion cyclotron waves in cold plasma, (T), 20: 20013 (NASA-TN-D-3361)

MAGNETIC FIELDS

charged-particle motion in time-dependent axially symmetric, (T), 20: 20023

configuration in polytropic stars, equilibrium, (T), 20: 19343

detection of small, circuit for, 20: 19771

distortions in helical, compensation of, (E/T), 20: 20080

effects of interplanetary, on geomagnetic fields, (E), 20: 19642 (N-65-23066)

effects of uniform, on laser-produced plasma expansion, (E), 20: 20045

effects of, combined with x radiation on barley seeds, 20: 18387

effects of, combined with x radiation on plant germination and seedling development, 20: 18388

effects of, combined with gamma radiation on Drosophila behavior, 20: 18410

effects on current-voltage characteristics of superconducting rings having insulating junctions, 20: 19770

effects on Drosophila behavior, 20: 18410

effects on magnetohydrodynamic turbulence in presence of Hall effect, (T), 20: 19634

effects on parameters of h-f discharge plasmas, (E), 20: 20087

effects on Pippard superconductors, gauge-invariant nonlocal theory for, 20: 19740

effects on plant germination and seedling development, 20: 18388

effects on x-irradiated barley seeds, 20: 18387

focusing properties of inhomogeneous, for mass separators, 20: 19163

intensity in solar corona, estimation from radio burst measurements, 20: 19355

ion orbit stability in eccentric, (T), 20: 19306 (ZfK-PhA-2)

plasma arc stability in axial, (E/T), 20: 20008 (N-65-22329)

plasma diffusion across, effects of microinstabilities on, (E), 20: 20017(R) (NYO-2813-36)

plasma oscillations in, initial-value problem for, (T), 20: 20004 (N-65-16489)

radiosensitivity effects on barley seeds, x, 20: 18387

superconducting sphere suspension in, (E), 20: 19728

trapping by theta-pinch plasma, end losses and contraction-wave collection rate from, (E), 20: 20060

MAGNETIC MATERIALS

neutron inelastic scattering by, survey on, 20: 19797

MAGNETIC MIRROR MACHINES

design of Q device, 20: 20018(R) (TID-22785)

development status of 2X and Scylla IV, 20: 20365

MAGNETIC MOMENTS

measurement of, produced by rotating superconductors, 20: 19771

MAGNETIC PROBES

signal sampling equipment for multi-coil, design of, 20: 19998 (CLM-R-50)

MAGNETIC PROPERTIES

of liquid and frozen water, 20: 18190(R) (UCRL-16613)

of organic compounds, ESR studies of effects of hydrogen atoms on, 20: 18295(R) (UCLA-12-576, pp 27-56)

MAGNETIC RESONANCE

spectra of ESR, analog system for integrating, 20: 19039 (RISO-M-233)

MAGNETO-OPTICAL ROTATION

theory of, in anisotropic plasma, 20: 20020

MAGNETOHYDRODYNAMIC CELLS

design and development of liquid-metal, 20: 20177(R) (BNL-929, pp 83-105)

performance using liquid metals, 20: 20201(R) (ANL-7110, pp 311-401)

plasma electric conductivity in, slightly ionized nonequilibrium, (T), 20: 19417(R) (N-65-21774)

properties of linear, with one or more loads, (T), 20: 19414 (AE-214)

use of electrodeless, in space power systems, 20: 19423 (N-65-27044)

MAGNETOHYDRODYNAMICS

fluid flow in progressive magnetic field, two-dimensional nonstationary, (E), 20: 19624

fluid flow turbulence in, in presence of Hall effect, (T), 20: 19634

gas flow boundary layer on thermally insulated semi-infinite flat plate, compressibility effects on, (T), 20: 19632

gas flow past wedge, shock wave stability in, (T), 20: 19631

jets confined by transferse magnetic field, evolution of, (E), 20: 19625

plasma flow through nozzles, containment properties of, (E), 20: 20300 (NP-15904)

plasma flow through nozzles, containment properties of, (T), 20: 20299 (NP-15903)

plasma jet velocity profiles in, affinity of excess, (E), 20: 19626

shock equations of classical and relativistic, 20: 19627

shock waves in relativistic, (T), 20: 19623

MAGNETOMETERS

calibration for synchrotron magnet measurements, 20: 19291 (CALT-68-67)

MAGNETOSPHERE

charged-particle motion in, adiabatic, (T), 20: 19640 (N-65-21332)

effects on ionospheric electron and ion temperatures, 20: 19648

electric field distribution in, model for, 20: 19674

electron content and density near ionization knee of, (E), 20: 19668

electron plasma oscillations in, (E/T), 20: 19644 (N-65-23933)

hydromagnetic oscillations in nonuniform, coupling resonance of, (T), 20: 19692

hydromagnetic wave amplification in, by cyclotron instability process, (T), 20: 19666

hydromagnetic waves in uniform cold, properties of three-dimensional, (T), 20: 19693

ionization density of, whistler determination of knee position in, (E), 20: 19667

structure of, effects on auroral storms and geomagnetic fields, 20: 19688

MAGNETS

design of superconducting, 20: 20365

development of superconductors for high-field, 20: 19724 (N-65-25286)

field distribution of 2-meter spark chamber, model for calculating, 20: 19041 (SLAC-57)

performance of AGS, 20: 19285(R) (BNL-929, pp 44-57)

performance of superconducting, for space power systems, 20: 19424 (NASA-TN-D-3345)

power supplies for synchrotron, flat topping of, 20: 19303 (PPAD-581D)

MAIZE

effects of ethyl methanesulfonate in, genetic, 20: 18334

mutations in, effects of ethylmethane sulfonate on, 20: 18184(R) (BNL-929, pp 115-25)

radiation effects in, genetic uv and x, 20: 18334

radiation effects on, mutagenic, 20: 18409

radiation effects on, following seed soaking in phosphorus-32 solutions, 20: 18442

radioinduced endosperm mutations in, frequency of γ, light, and uv, 20: 18392

radioinduced mutations in pollen mother cells of, γ, 20: 18335

use as radiation dosimeter during space flight, 20: 18964

MALEIC ACID

maleic acid–2-propanol, radiolysis yields in, 20: 18730 (UJV-1468)

MAMMALS

effects of chemical radioprotective compounds on, effects of biological and chemical factors on, 20: 18472

MAMMARY GLAND

radioinduced tumors in rat, effects of exposure fractionation and protraction on gamma, 20: 18319

radiotherapy of carcinomas of, dosimetry in γ, electron, and x, 20: 18545

radiotherapy of carcinomas of, effects on hematopoiesis, 20: 18552

MAN

age estimation of bones and tools of prehistoric, by carbon-14 method, 20: 18937

barium-133 metabolism in, 20: 18226

calcium-47 metabolism in, 20: 18226

cesium-137 content in, September 1962 to August 1963, 20: 18961

cesium-137 content in U. S., 1965, 20: 18973

cesium-137 content in, 1956 to 1965 whole-body, 20: 18203(R) (LA-3432, pp 21-55)

cesium-137 content in, 20: 18220

cesium-137 content in, effects of age and diet on, 20: 18233

cesium-137 content in, effects of diet on, 20: 18234

iodine-131 uptake by, effects of food contamination on, 20: 18211(R) (UCLA-12-576, pp 88-111)

iodine-131 uptake by thyroid gland of, effects of environmental contamination on, 20: 18941(R) (IDO-12047)
photosensitivity of skin of, effects of furocoumarins on, 20: 18466
potassium-40 content in, September 1962 to August 1963, 20: 18961
radiation dose to thyroid of, from accidental iodine-131 release at nuclear facilities, 20: 18983
radiation doses to astronauts during ninth Mercury-Atlas mission, 20: 18942 (N-65-17115)
radiation effects on bone marrow and granulocyte blood picture of, x, 20: 18381
radiation effects on, review, 20: 20367
radiation effects on DNA synthesis in embryonic cells from, x, 20: 18264
radiation effects on development of fetuses and babies of, diagnostic-radiography, 20: 18536
radiosensitivity of, effects of pyridine diphosphate nucleotides on, 20: 18535
radium-233 metabolism in, 20: 18226
strontium-85 metabolism in, 20: 18226
urinary content of tritium-labeled estrogens and ketosteroids after labeled testosterone injection, 20: 18230
zinc metabolism in cirrhotic and normal liver of, tracer study, 20: 18222

MANGANESE
content and distribution in shallow marine environments, 20: 18895 (NYO-3450-1, pp 217-76)
content in calcites in Providencia area, Zacatecas, Mexico, 20: 18631 (NYO-2266-1)
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
determination in botanical materials, activation, 20: 18602
determination in quartz crystals from Providencia area, Zacatecas, Mexico, activation, 20: 18631 (NYO-2266-1)
determination in sea water, activation, 20: 18576(R) (TID-22660)
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
radiation effects at low temperatures on resistance of alpha-, proton, 20: 19269
separation from rare earths by ion exchange chromatography, 20: 18827

MANGANESE ALLOYS
Er–Mn, magnetic structure of intermetallic compound $ErMn_2$ in, 20: 18556(R) (BNL-929, pp 66-82)
Mn–Ni, magnetic structure of, from polarized neutron scattering, 20: 20335
Mn–Pd, magnetic properties of Mn_2Pd_3, 20: 20360(R) (PRNC-73)
Mn–Tb, magnetic structure of intermetallic compound $TbMn_2$ in, 20: 18556(R) (BNL-929, pp 66-82)
Mn–Tm, magnetic structure of intermetallic compound Mn_2Tm in, 20: 18556(R) (BNL-929, pp 66-82)

MANGANESE BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702

MANGANESE IONS
precipitation with calcite at 40 to 325°C from aqueous solutions, 20: 18631 (NYO-2266-1)

MANGANESE ISOTOPES Mn-51
beta decay of, log ft values for, (T), 20: 19932

MANGANESE ISOTOPES Mn-52
beta decay of, log ft values for, (T), 20: 19932
nuclear magnetic dipole moments for, (T), 20: 19932

MANGANESE ISOTOPES Mn-54
content in organisms and water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
deposition on platinum anode, effects of hydrogen ion concentration on, 20: 18676
distribution of injected, in rat tissues, 20: 18203(R) (LA-3432, pp 21-55)
separation from copper-64 and zinc-65 in sea water, method for, 20: 18576(R) (TID-22660)
solvent distribution between bis(2-chloroethyl) ether and hydrochloric acid, coefficient of, 20: 18571 (ORNL-TM-1420)
sorption from sea water by montmorillonite clay, 20: 18576(R) (TID-22660)

MANGANESE ISOTOPES Mn-55
neutron capture at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
use in neutron detection by resonance activation, 20: 19018(R) (ANL-7110, pp 231-310)

MANGANESE ISOTOPES Mn-56
dosimetry of, equation for internal, 20: 18955

MANGANESE NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)

MANGANESE OXIDES
magnetic properties of, determination of, by neutron diffraction, 20: 20360(R) (PRNC-73)
sorptive properties for radiocolloids of ruthenium-106, effects of pH on, 20: 18847

MANGANESE STEEL
Cr–Mn–Ni, mechanical properties of austenitic cast, at 2.5 to 4.5°K, 20: 19232
Mn–Mo, mechanical properties of A302-B, effects of cold-working and heat treatments on, 20: 19205(R) (GA-6923)
Mn–Mo, radiation effects on mechanical properties of SA302B, fast-neutron, 20: 19178(R) (IDO-17154)
Mn–Mo–Ni–Nb, radiation effects on mechanical properties of low-alloy, neutron, 20: 19258 (UJV-1470/65)

MANGANESE TELLURIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148

MARCOULE REACTORS (G-2)
coolant properties in, analysis of, 20: 20232 (CEA-R-2847)
heat exchangers for, radioprotection during work on, 20: 20233 (CEA-R-2870)

MARCOULE REACTORS (G-3)
coolant properties in, analysis of, 20: 20232 (CEA-R-2847)
heat exchangers for, radioprotection during work on, 20: 20233 (CEA-R-2870)

MASERS
gain mechanism in cyclotron, quantum mechanical properties of, 20: 19462

MASERS (OPTICAL)
beam intensity calculation from multiphoton processes, (T), 20: 19356 (CEA-R-2888)
beam reactions with gases, plasma production from, (E), 20: 20045
beam scattering by dense theta-pinch plasma, electron density and temperature measurement from, (E), 20: 20043
performance of carbon dioxide, Fermi resonance and isotope shift effects on, (E), 20: 19937
photon processes in, (T), 20: 19356 (CEA-R-2888)
pumping of, efficiency of nuclear, 20: 20201(R) (ANL-7110, pp 311-401)
radiation effects on ruby, x, 20: 20110 (NASA-TN-D-3379)
use in production of electrons, 20: 19283

MASS SPECTROGRAPHY
of transuranic elements, 20: 20365

MASS SPECTROMETERS
beam focusing device for, 20: 19013(P)
beam focusing in, inhomogeneous magnetic fields for, 20: 19163
collection efficiency of, tracer technique for determining, 20: 19150
collector contamination in, tracer determination of, 20: 19149
collector design for adsorption studies using, 20: 18994 (SGAE-PH-31/1965)
conference on, 20: 19141
contamination in, effect of gas scattering on, 20: 19146
description and uses of LNR-JINR, 20: 19156
design and operation of Colutron Mark II velocity-filter, 20: 19162
design and performance of 255° double-focusing, 20: 19160
design modifications of Argonne, 20: 19159
design of electrostatic, 20: 18995 (SGAE-PH-39/1966)
design of 360°-deflection, (T), 20: 18998
design perspectives for, 20: 19155
development of multi-ion source, for isotope separation, 20: 19140
filament assemblies for, equipment for loading boron, plutonium, and uranium in, 20: 18568(R) (NBL-230)
ion beam formation in sector-type, 20: 19144
ion source for Orsay, performance of thermal, 20: 19142
ion sources for Orsay, design and performance of, 20: 19143
ion sources for, design and performance of high-temperature hollow-cathode, 20: 19002
ion sources for, plasma-compression, 20: 19001
operation and optimization of, with reduced magnetic field volume, 20: 19158
performance for isotope separation, 20: 19145
performance for preparation of nuclear reaction targets, 20: 19167
performance of Karlsruhe, for lead and antimony isotopes, 20: 19147
use for isotope separations at Princeton-Pennsylvania accelerator, 20: 19889
use for preparation of radiation targets, 20: 19151
use for study of ion reactions with chemical compounds, 20: 18780
use in preparation of radioactive samples, 20: 19166
use of multi-ion source, 20: 19157
use of Seibersdorf, in nuclear physics, 20: 19164
use on-line for lithium-8 and -9 detection in proton reactions with carbon, 20: 19886
use on-line for separation of krypton and xenon isotopes, 20: 19887

use on-line with CERN synchrocyclotron for nuclear decay studies, 20: 19885
MATERIALS TESTING
development of nondestructive methods for, 20: 19178(R) (IDO-17154)
use of strain gages in, 20: 18880 (Y-RD-5)
MATHEMATICS
Bessel functions in, calculation of integrals for, 20: 19170 (CEA-R-2927)
calculation of Laplace transforms, numerical, 20: 20201(R) (ANL-7110, pp 311-401)
eigenfunction expansions and group representations in, 20: 19172 (IC-66/12)
equations in, computer program for complex zeros of arbitrary, 20: 19997 (CLM-R-48)
Lie algebra in, special functions for, 20: 19174
methods development for evaluation of functions, 20: 20201(R) (ANL-7110, pp 311-401)
methods for radiological target analysis, 20: 18938 (AD-629784)
research programs at BNL on, 20: 19169(R) (BNL-929, pp 106-11)
MATTER
binding energy of nuclear, (T), 20: 19983
neutrino motion in superdense, partial external trajectories of, (T), 20: 19446 (NP-15932)
MEATS
radiation effects on toxoplasma infections in, γ, 20: 19122
MECHANICS
many-body systems in classical, eigenfunctions of Liouville operator in, 20: 19280
particle collisions in relativistic, energy conservation in, 20: 19275
MEDICAL PERSONNEL
radiation dose to gonads of, in radiographic procedures, 20: 18505
MEDICINE
nuclear energy in, review, 20: 20367
radioisotope use in, instrumentation and methods for, 20: 19091
radioisotopes for use in, cyclotron production of short-lived, 20: 18515
radioisotopes in, local energy deposition values for, 20: 18958
research programs on, at Argonne Cancer Research Hospital, 1965, 20: 18422(R) (ACRH-24)
stable isotope uses in, 20: 19120
MEIOSIS
radioinduced mutations in maize during pollen, γ, 20: 18335
MEMBRANES
material transport across biological, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on ionic permeability of muscle cell, 20: 18293 (NP-14898)
radiation effects on permeability of erythrocyte, effects of iodoacetic acid and related compounds on x, 20: 18468
radiosensitivity of erythrocyte, effects of temperature on, 20: 18454
MEMORY DEVICES
storage systems for, use of superconducting thin films in, 20: 19720 (CEA-Bib-65)
MERCAPTO GROUP
radiation effects on content of, in *Serratia marcescens* cells, x, 20: 18448
radiosensitivity effects of endogenous, in mice, x, 20: 18433
radiosensitivity effects of, reaction mechanisms for, 20: 18274
reactions with β-hydroxyethyl-2-4-dinitrophenyl disulfide, 20: 18722
MERCURY
corrosive effects on Croloy 9M at 1074°F, 20: 19189 (N-65-21161)
determination in potato flour, mercury-197 separation in neutron activation, 20: 18595
electric double layer in discharge plasma of, thickness of cylindrical, (E), 20: 20086
electron double-elastic scattering by solid, spin polarization from, (E), 20: 19376
energy levels of, radiative lifetime for, (E), 20: 19360 (UCRL-16441)
heat transfer from flowing, 20: 20177(R) (BNL-929, pp 83-105)
microwave amplification in plasma of, 20: 20052
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
photosensitivity effects on germane and silane systems, formation of volatile hydrides by, 20: 18729(R) (NYO-2007-9)
solvent properties for refractory metals, 20: 20177(R) (BNL-929, pp 83-105)
MERCURY ALLOYS
Hg–rare earth–transition metal, preparation of rare earth–transition metal alloys by heating, 20: 19185
In–Hg, indium-115 NMR in liquid, 20: 20157
MERCURY CHLORIDES
enthalpy of vaporization and vapor pressure of molten, to critical point, 20: 18634 (SRIA-106-37)
MERCURY IONS
production of beams of, using duoplasmatron, 20: 19004
MERCURY ISOTOPES
mass spectra from proton reactions with lead, use of isotope separator for, 20: 19889
MERCURY ISOTOPES Hg-185
nuclear data, 20: 19882
MERCURY ISOTOPES Hg-197
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
separation from other products in neutron activation analysis of potato flour for mercury, 20: 18595
MERCURY ISOTOPES Hg-203
calibration of, for determining efficiency of thin crystal scintillation detector, 20: 18562(R) (EUR-2640.e)
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
MERCURY ISOTOPES Hg-204
alpha decay energy of, effect of shell structure on, (T), 20: 19848
MERCURY ISOTOPES Hg-206
alpha decay energy of, effect of shell structure on, (T), 20: 19848
MERCURY ISOTOPES Hg-208
alpha decay energy of, effect of shell structure on, (T), 20: 19848
MERCURY ISOTOPES Hg-210
alpha decay energy of, effect of shell structure on, (T), 20: 19848
MERCURY ISOTOPES Hg-212
alpha decay energy of, effect of shell structure on, (T), 20: 19848
MERCURY SYSTEMS
Ar–Hg, r-f resonance measurement of electric conductivity of discharge plasma of, 20: 20088
MESITYL OXIDE
solvent properties for uranium, 20: 18605
MESON BEAMS
effects on chromosomes in root meristems, 20: 18190(R) (UCRL-16613)
effects on tumors in mice, biological, 20: 18190(R) (UCRL-16613)
use in radiotherapy, feasibility of, 20: 18516
use of high-LET, for therapy, 20: 18507 (BNL-10009)
MESON PAIRS
photoproduction cross sections of (μ), nuclear magnetic effects on, (T), 20: 19968
MESONS
bootstrap model for vector, SU(3) symmetry in, 20: 19564
decay of vector, algebra of currents for, 20: 19541 (UR-875-121)
decay of, partial conservation of tensor current for electromagnetic, (T), 20: 19536 (IC-66/25)
decay of, selection rules for leptonic, 20: 19436 (ANL-7130, pp 159-88)
detection of scalar ($J_p = 0^+$), (E/T), 20: 19273(R) (BNL-929, pp 3-43)
exchange interactions of, products from, (E/T), 20: 20365
field equations for scalar, geometrization of, 20: 19553
interactions of scalar neutral, upper bound on coupling constant for, 20: 19569
interactions of separate-singlet vector, relation to neutron electric form factor in U(6), 20: 19572
interactions of spin-0, spin-0-meson bound states from N/D calculations for two-body, 20: 19490
interactions with nucleons, coupling constants for, (T), 20: 19521
interactions with baryons, SU(6) predictions for, 20: 19579
production facility for, neutron flux beneath shield of, (T), 20: 20100 (ORNL-TM-1423)
production in nuclear reactions with nuclei at high energy, 20: 19458
properties of, (E/T), 20: 19448 (UCRL-16462)
properties of 2+ nonet of, in SU(3) theory, 20: 19512
MESONS, RESONANCE
exchange of 2+, in meson–nucleon and nucleon–nucleon interactions, (T), 20: 19512
model for, quark, (T), 20: 19531
production and properties of F*, (E/T), 20: 20365
production of (A_1) and (A_2) in meson (π)-proton interactions, (E), 20: 19449 (UR-875-123 and (Add.))
production of f*, 20: 19273(R) (BNL-929, pp 3-43)
properties of, (E/T), 20: 19533 (BNL-9934)
properties of, (E/T), 20: 19448 (UCRL-16462)
MESONS (B)
production in meson (π)-proton interactions above 2.5 Bev/c, (E), 20: 19449 (UR-875-123 and (Add.))
MESONS (D)
properties and production, (E/T), 20: 20365
MESONS (f)
exchange in meson–nucleon and nucleon–nucleon interactions, (T), 20: 19512
MESONS (f°)
production in proton–antiproton annihilations at 5.7 Bev/c, (E), 20: 19498
MESONS (K)
decay of, current commutation relations for leptonic, 20: 19479
decay of, T violation in meson (μ) polarization in, (T), 20: 19488

interactions of, CP violation in weak, (T), 20: 19480
interactions with mesons (π), algebra of currents for, 20: 19541 (UR-875-121)
interactions with nucleons, 2+ meson exchange in, (T), 20: 19512
interactions with mesons (K), coupling constants and p-wave amplitudes for, (T), 20: 19520
photoproduction on deuterons and nucleons, isotopic relations for amplitudes of, (T), 20: 19518
MESONS (K^-)
capture by bromotrifluoromethane, Λ-p effective-mass spectrum and hyperon (Λ) lifetime from, (E), 20: 19485
interactions with protons at high energies, resonances from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with protons, KNΛ and KNΣ coupling constant ratio from baryon exchange in, (T), 20: 19487
interactions with mesons (K), coupling constants and p-wave amplitudes for, (T), 20: 19520
MESONS (K^0)
decay modes of K^0_2, (E), 20: 19431 (ANL-7130, pp 77-81)
decay of K^0_2, CP violation in, (E/T), 20: 19428 (ANL-7130, pp 17-28)
decay of K^0_2, CP invariance in 3π, (E/T), 20: 19429 (ANL-7130, pp 59-66)
decay of K^0_2, 3π, (E), 20: 19430 (ANL-7130, pp 67-75)
decay of K^0_2, CP violation in, (T), 20: 19443 (JINR-E-2614)
decay of K^0_2, CP violation in 2π, (T), 20: 19474
decay of K^0_2, 2π, (E), 20: 19507
decay of K^0_2, CP violation in, (T), 20: 19608
decay of K^0_2, CP violation in, (T), 20: 19528
decay of, CP invariance in, (E/T), 20: 20365
decay of, CP violation in 2π, (T), 20: 19461
decay of, CP-invariance violation in, 20: 19273(R) (BNL-929, pp 3-43)
decay of, energy dependence of form factors in three-body leptonic, (E), 20: 19432 (ANL-7130, pp 83-90)
decay of, form factors for three-body muonic, (E/T), 20: 19433 (ANL-7130, pp 91-105)
decay of, time distribution in, (E), 20: 19435 (ANL-7130, pp 153-7)
mass of K^0_1 and K^0_2, difference in, 20: 19437 (ANL-7130, pp 215-30)
production of K^0_2, in meson (K^0_2)–proton interactions, (E), 20: 19507
regeneration of K^0_1, 20: 19437 (ANL-7130, pp 215-30)
MESONS ($\bar{K}^0$)
decay of, CP violation in 2π, (T), 20: 19461
MESONS (K^+)
decay of, branching ratio for two-body leptonic, (E), 20: 19434 (ANL-7130, pp 107-13)
decay of, selection rules for leptonic, 20: 19436 (ANL-7130, pp 159-88)
decay products from spectra of, (E), 20: 19273(R) (BNL-929, pp 3-43)
production in proton interactions at 2.4 to 2.85 Bev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
MESONS (K^0_{e3})
decay of, energy dependence of form factors in, (E), 20: 19432 (ANL-7130, pp 83-90)
MESONS (K_{e4})
decay of, selection rules for leptonic, 20: 19436 (ANL-7130, pp 159-88)
MESONS ($K^0_{\mu 3}$)
decay of, form factors for, (E/T), 20: 19433 (ANL-7130, pp 91-105)
MESONS ($K^+_{\mu 3}$)
decay of, form factor ratio in, 20: 19524
MESONS (μ)
capture by nuclei, review on, 20: 19459
decay of, electron spectra from, (E/T), 20: 19503
magnetic moment, (T), 20: 19525
scattering by protons, angular distributions from, (E/T), 20: 20365
MESONS (μ^-)
capture in liquid hydrogen, (E/T), 20: 19374
production in electron–neutrino interactions, (T), 20: 19463
MESONS (μ^+)
production in electron–neutrino interactions, (T), 20: 19463
MESONS (ω)
decay of, electromagnetic interactions in $\bar{U}(12)$ symmetry in, 20: 19568
effects of $\omega\phi$ mass splitting, on electromagnetic form factors in collinear U(6), 20: 19572
production in meson (π^+)-neutron interactions, Regge-pole analysis of, 20: 19510
MESONS (ϕ)
effects of $\omega\phi$ mass splitting, on electromagnetic form factors in collinear U(6), 20: 19572
model for, $K\bar{K}$ interactions for dynamical, 20: 19520
MESONS (π)
capture by light nuclei, two-nucleon emission from, (T), 20: 19843 (UR-875-126, Paper 2)
capture by molybdenum isotopes, x-ray spectra from, (E), 20: 19273(R) (BNL-929, pp 3-43)
decay of, current commutation relations for leptonic, 20: 19479
decay of, transverse meson (μ) polarization in, (T), 20: 19488
interactions with protons at 4 to 12 Bev, elastic, (E), 20: 19273(R) (BNL-929, pp 3-43)
interactions with neutrons at 1.7 Bev/c, products from, (E/T), 19273(R) (BNL-929, pp 3-43)
interactions with mesons (K), algebra of currents for, 20: 19541 (UR-875-121)
interactions with bound nucleons at high energies, elastic, (E/T), 20: 19444 (LYCEN-6527)
interactions with nucleons at 300 to 700 Mev, absorption parameters and phase shifts for, (T), 20: 19481
interactions with nucleons, dynamics with invariant collinear vertices, analyticity, and unitarity for low-energy strong, (T), 20: 19491
interactions with protons at 1 to 3 Bev/c, proton polarization in elastic, (E/T), 20: 19505
interactions with protons, 2+ meson exchange in, (T), 20: 19512
interactions with baryons, coupling constants for, (T), 20: 19539 (JINR-E-2544)
interactions with nucleons, SU(3) symmetry in bootstrap model for, 20: 19564
interactions with mesons (π) and nucleons at low energies, analysis using dispersion relations, (T), 20: 19522
photoproduction on nucleons, corrections to static theory for, 20: 19447 (UCRL-14614-T)
photoproduction on deuterons and nucleons, isotopic relations for amplitudes of, (T), 20: 19518
photoproduction on baryons, amplitudes for, (T), 20: 19539 (JINR-E-2544)
production in antineutrino-proton and neutrino-neutron interactions, cross sections for, (E), 20: 19438 (ANL-7130, pp 257-71)
production in neutrino–nucleon interactions, interpretation of asymmetries in, 20: 19478
production in nucleon interactions, p-wave analysis of, 20: 19476
production of, dynamics with invariant collinear vertices, analyticity, and unitary for, low-energy, (T), 20: 19491
MESONS (π^-)
capture by nuclei $3 \leq Z \leq 13$, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
dosimetry of, using ionization chambers and lithium fluoride dosimeters, 20: 18516
effects on tissue, 20: 18185(R) (BNL-929, pp 126-47)
interactions with deuterons, dynamical theory for final-state, 20: 19273(R) (BNL-929, pp 3-43)
interactions with protons at 24 Bev, forward amplitudes for, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with deuterons at high energies, resonances from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with protons above 2.5 Bev/c, meson (A_1), (A_2), and (B) production in, (E), 20: 19449 (UR-875-123 and (Add.))
interactions with protons, peripheral model for Y^*_1 resonance production in, 20: 19469
interactions with protons, sum rules for real part of forward amplitude for, 20: 19470
interactions with nucleons in emulsions at 17.2 Bev, mass distributions from, (T), 20: 19472
interactions with protons above 2.9 Bev, polarization in, (T), 20: 19473
interactions with protons at 2 to 12.4 Bev/c, differential cross sections for elastic, (T), 20: 19483
interactions with protons at 2.01 to 2.08 Bev/c, polarization in elastic, (T), 20: 19484
interactions with protons, KNΛ and KNΣ coupling constant ratio from baryon exchange in, (T), 20: 19487
interactions with protons at 39 Mev, charge-exchange and elastic, (E), 20: 19515
interactions with protons at 365 Mev, recoil-proton polarization in elastic, (E), 20: 19495
production in proton–antiproton annihilations at 5.7 Bev/c, (E), 20: 19498
properties of, review of physical, 20: 18516
reactions (π^-,n) with copper, neutron energy spectra from, (T), 20: 19903
MESONS (π^0)
decay of, electromagnetic interactions in $\bar{U}(12)$ symmetry in, 20: 19568
photoproduction of, predictions for multipole $E^{3/2}_{1+}$ in, (E/T), 20: 19493
MESONS (π^+)
interactions with protons at 14 Bev, forward amplitudes for, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with protons above 2.5 Bev/c, meson (A_1), (A_2), and (B) production in, (E), 20: 19449 (UR-875-123 and (Add.))
interactions with protons, sum rules for real part of forward amplitude for, 20: 19470
interactions with protons above 2.9 Bev, polarization in, (T), 20: 19473
interactions with neutrons, Regge-pole analysis of meson (ω) production in, (T), 20: 19510
lifetime, (E), 20: 19451 (UR-875-126, Paper 3)

production in proton–antiproton annihilations at 5.7 Bev/c, (E), 20: 19498
reactions (π^+,2p) with lithium-6 at 30-Mev, excited states from, (E), 20: 19912
scattering by carbon-12 at 3 Bev, cross sections for inelastic, (T), 20: 19823 (JINR-P-2431)

MESONS (ρ^0)
interactions with nucleons, total cross section for, (T), 20: 19506
photoproduction on nuclei, (T), 20: 19506
production in proton–antiproton annihilations at 5.7 Bev/c, (E), 20: 19498

MESONS (X^0)
decay scheme, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
properties and production, (E/T), 20: 20365

METABOLISM
effects of cystamine on yeast-cell, 20: 18372
radiation effects on yeast-cell, β, 20: 18372
radiation effects on animal-cell, effects of dose-modifying chemical compounds on, 20: 18444
rate of animal, double tracer technique for measurement of, 20: 18211(R) (UCLA-12-576, pp 89-111)

METAL COMPLEXES
formation by sulfoxides, 20: 20360(R) (PRNC-73)
formation in aqueous solutions, 20: 18449
role in reactions of radioprotective compounds, 20: 18449

METALLIC FILMS
damage by fission fragments, 20: 20183

METALLIC FOILS
heat transfer in porous air-cooled aluminum, using radiant heat source, 20: 18875

METALLOGRAPHY
sample preparation in, vibratory grinding and polishing method and fixture for, 20: 19176 (ANL-6975)
sample preparation, procedures and standards for uranium, 20: 19180 (NLCO-954)

METALLURGY
radioisotope uses in, 20: 19128
research programs on, for production of pure metals, 20: 20365

METALS
abundances in stars, two-color diagram for, (T), 20: 19347
boiling heat transfer by liquid, 20: 18870(R) (SAN-409-28)
book: *Superconductivity of Metals and Alloys*, 20: 19773(T)
coating with uranium oxide by electrolysis, effects of electrolyte on, 20: 18691
corrosion of, measurement of, by beta backscattering and x-ray induction methods, 20: 19196
crystal structure of, analysis using inelastic scattering of thermal neutrons, 20: 20170
defects in, research on point, 20: 19273(R) (BNL-929, pp 3-43)
electron transport through thin films of, 20: 19097 (N-65-17886)
lattice defects in, electron microscopy of, 20: 20365
Mössbauer effect in, uses of, 20: 20162
neutron scattering by liquid, review on, (E), 20: 19799
physiology of trace, study by activation and isotopic methods, 20: 18185(R) (BNL-929, pp 126-47)
positron annihilation in, (T), 20: 19499
production in contracting gaseous spheres, (T), 20: 19345
production of high-purity, methods for, 20: 20365
properties at high temperature, bibliography on, 20: 19216 (NP-15388)
radiation effects on body-centered cubic, 20: 20177(R) (BNL-929, pp 83-105)
radioinduced hardening of bcc, neutron, 20: 20183
reactions with water at high temperatures, 20: 20183
solubility of refractory, in mercury, 20: 20177(R) (BNL-929, pp 83-105)
superconductivity of, effects of communal entropy of crystal structure on, (T), 20: 19734
thermionic work functions of cesium-coated surfaces of, method for measuring, 20: 19422 (N-65-26628)
use of liquid, in SNAP cooling and power cycles, 20: 20303

METASTASES
radiodiagnosis of bone, using strontium-85, 20: 18513

METEORITES
age estimation of, methods for, 20: 20365
age, composition, and histories of, 20: 18556(R) (BNL-929, pp 66-82)
formation and ages of, potassium-40 abundance for determination of, (E), 20: 19341
origin of, chemical evidence relative to, 20: 19346
potassium-40 abundance in, variations in, (E), 20: 19341
sulfur isotope content in, 20: 18909
xenon-129 transport in, mechanism of, 20: 18901

METEOROLOGY
effects on fallout, 20: 18198
effects on iodine-131 deposition on forage plants, 20: 18941(R) (IDO-12047)
models for particle diffusion over long distances, 20: 18988(R) (ORNL-929, pp 58-66)

METHACRYLIC ACID
radioinduced polymerization, 20: 18794

METHACRYLIC ACID, METHYL ESTER POLYMERS
Cherenkov light absorption in lucite, (E), 20: 19021 (CALT-68-53)
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

METHACRYLIC ACID POLYMERS
properties of, effects of chain transition on physicochemical, 20: 18794

METHANE
reactions with deuterium and tritium ions, spectral studies on, 20: 18657
spectra of, isotope effects on C–H vibrational transition probability in, 20: 18639
thermal conductivity of liquid, 20: 19614 (N-65-17283)
vapor pressure of, isotope effects on, 20: 18556(R) (BNL-929, pp 66-82)
yields from gamma radiolysis of polypropylene, effects of nitrous oxide on, 20: 18770
yields from radiolysis of iodomethane in cyclohexene, tracer studies of, 20: 18771
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)

METHANE, BROMOTRIFLUORO-
meson (K^-) capture by, Λ-p effective-mass spectrum and hyperon (Λ) lifetime from, (E), 20: 19485

METHANE, CHLOROTRIFLUORO-
Ar–chlorotrifluoromethane, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
chlorotrifluoromethane–H, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
chlorotrifluoromethane–N, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)

METHANE, DICHLORO-
labeling with carbon-14, 20: 18708

METHANE, DIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

METHANE, IODO-
cyclohexene–iodomethane, radiolysis of, tracer studies of yields from, 20: 18771
methyl iodide–SiH_4, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)

METHANE, NITRO-
electrochemical reduction of, effects of dielectric constant of organic solvent on, 20: 18636(R) (TID-22725)

METHANE, TETRAPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

METHANESULFONIC ACID, ETHYL ESTER
effects on maize, genetic, 20: 18334

METHANOL
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
efficiency of, with toluene for carbon-14 dating by liquid scintillation counting, 20: 18935
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
radiolysis of, effects of catalysts on yields from, 20: 18744
GeH_4–methanol, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)
methanol–pyridine, radiolysis of, yields of hydrogen from gamma, 20: 18736
methanol–H_2O, radiolysis of, yields of hydrogen from gamma, 20: 18736

METHIONINE
labeling with tritium following radiolysis of ribonuclease, 20: 18749
radiation chemistry of, uv and x, 20: 18791

METHYL BORATES
efficiency of, with toluene for carbon-14 dating by liquid scintillation counting, 20: 18935

METHYL GROUP
analysis of, for carbon-14 and tritium, 20: 18600

METHYL SULFOXIDE
effects on Wolff-Kishner reactions of hydrazones, 20: 20360(R) (PRNC-73)
effects on yeasts, 20: 18206(R) (N-65-16815)
radiosensitivity effects on catalase, 20: 18449

METHYLIDYNE
production by reactions of carbon-11 with hydrogen, 20: 18716
reactions with ethylene, 20: 18716

MEXICO (ZACATECAS)
geology and mineralogy of Providencia area in, 20: 18631 (NYO-2266-1)

MICA
age estimation of, by argon–potassium method, in Ontario, Canada,

20: 18929

MICE
antibody-antigen reactions to *Schistosoma mansoni* cercariae, 20: 20360(R) (PRNC-73)
cesium-137 metabolism in, effects of metabolic rate and temperature, 20: 18203(R) (LA-3432, pp 21-55)
chromosome pattern of, 20: 18286 (EUR-2462.1)
effects of immune reactions on reticulo-endothelial function in, 20: 18190(R) (UCRL-16613)
effects of nitrogen mustards on, protective effects of mycelium-derived nucleotides against toxic, 20: 18452
effects of nitrogen mustard on, effects of thioglycollic acid derivatives on toxic, 20: 18474
effects of radiomimetic substances on tumors in, effects of radioprotective compounds on, 20: 18475
effects of radioprotective compounds on, delayed toxic, 20: 18488
erythropoiesis in, tracer study, 20: 18304
erythropoietic activity of spleen in lethally irradiated, effects of injected bone marrow on, 20: 18295(R) (UCLA-12-576, pp 27-56)
leukemogenesis in newborn, effects of bone marrow injections on urethan-induced, 20: 18191
leukemogenesis in newborn, effects of thymectomy and subsequent thymus implantation on urethan-induced, 20: 18192
metabolism in, effects of cystamine on, 20: 18240
physiology of thymus tissues in, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiation effects on resistance to dengue virus in, gamma and x, 20: 20360(R) (PRNC-73)
radiation effects on, β, 20: 18353
radiation effects on chromosomes in, distant-irradiation, 20: 18356
radiation effects on hematopoietic tissues in, γ and protons, 20: 18364
radiation effects on cellular reproduction in, survival curve analysis of γ, 20: 18370
radiation effects on head of, pathological γ, 20: 18376
radiation effects on nervous system of, γ, 20: 18376
radiation effects on toxicity of amphetamine in, x, 20: 18380
radiation effects on transplanted tumors in, electron and x, 20: 18396
radiation effects on estrus cycle in, *in utero*-exposure x, 20: 18403
radiation effects on embryos of, teratologic, 20: 18404
radiation effects on, protective effects of 5-methoxytryptamine against x, 20: 18430
radiation effects on, protective effects of endogenous sulfhydryl groups against x, 20: 18431
radiation effects on, protective effects of endogenous sulfhydryl compounds against x, 20: 18433
radiation effects on fetuses of, protective effects of splenectomy against, 20: 18436
radiation effects on, effects of adrenal hormones on x, 20: 18437
radiation effects combined with acceleration or vibrations on mitosis in marrow cells of, x, 20: 18439
radiation effects on, protective effects of chemical agents against γ and proton, 20: 18440
radiation effects on, 2.2-Bev proton, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on eyes of, x, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on fertility of, chronic low-level γ, 20: 18211(R) (UCLA-12-576, pp 89-111)
radiation effects on, after exposure of 35 generations, 20: 18289(R) (LA-3432, pp 56-101)
radiation effects on, effective residual dose for γ, 20: 18289(R) (LA-3432, pp 56-101)
radiation effects on erythropoiesis in, γ, 20: 18289(R) (LA-3432, pp 56-101)
radiation effects on DNA synthesis in embryonic cells from, x, 20: 18265
radiation effects on DNA synthesis in ascites tumor cells from, x, 20: 18266
radiation effects on dehydrogenase and transaminase activity in spleens of, 20: 18280
radiation effects on sensitivity to antigen-antibody complex in, 20: 18282
radiation effects on cells in peritoneal cavity of, morphological x, 20: 18285 (AD-630103)
radiation effects on chromosomes of, β, 20: 18286 (EUR-2462.1)
radiation effects on growth of cellular transplants in, genetic effects on x, 20: 18304
radiation effects on, during simulated space flight, gamma, 20: 18443
radiation effects on growth of transplanted tumors in, x, 20. 18460
radiation effects on survival in, protective effects of 5-BUdR, MEA, and combined 5-BUdR and MEA against x, 20: 18498
radiation effects on, protective effects of psychotropic drugs against x, 20: 18501
radiation effects on pigments in hair of, protective effects of melanogenetic substrates against x, 20: 18502
radiation injuries of, effects of drugs affecting central nervous system on, 20: 18459
radiation injuries in, effects of quinoxaline-di-N-oxide on, 20: 18465
radiation injuries to, protective effects of chemical compounds against low-dose, 20: 18473
radiation injuries of, protective effects of thioglycollic acid derivatives against, 20: 18474
radiation injuries of, effects of cysteamine and prochlorperazine on, 20: 18491
radiation injuries of, effects of bacterial toxins on, 20: 18496
radioactivity of, effects of AET on γ, 20: 18509(R) (UCLA-12-576, pp 61-80)
radioinduced dominant lethals in spermatozoa of, effects of dose on x, 20: 18351
radioinduced leukemogenesis in C57BL, mechanism for, 20: 18317
radioinduced leukemia in germfree, x, 20: 18371
radioinduced lymphosarcomas in, etiology of x, 20: 18359
radioinduced mutations in, effects of time between irradiation and conception on frequency of fission-neutron, 20: 18368
radiosensitivity effects of amines in, 20: 18454
radiosensitivity effects of ozone on, 20: 18454
radiosensitivity effects of methandrostandiol in, 20: 18477
radiosensitivity of, effects of bacterial toxins on, 20: 18425
radiosensitivity of antibody response in, 20: 18185(R) (BNL-929, pp 126-47)
radiosensitivity of, effects of colchicine derivatives and urethane on x, 20: 18467
radiosensitivity of, effects of nitrated procainamide derivatives on, 20: 18478
radiosensitivity of, effects of organophosphorus compounds on, 20: 18482
radiosensitivity of, effects of dithiosuccinic acid on, 20: 18483
radiosensitivity of, effects of cyclic analogs of AET on, 20: 18484
radiosensitivity of, effects of pantothenic acid on, 20: 18486
radiosensitivity of, effects of mixed radioprotective compounds on, 20: 18488
radiosensitivity of, effects of 5,7-dihydroxy isoflavone compounds on, 20: 18489
radiosensitivity of, effects of 4-hydroxybutyrate compounds on, 20: 18490
radiosensitivity of, effects of AET and DNA on, 20: 18492
radiosensitivity of, effects of heterologous spleen extraction, 20: 18493
radiosensitivity of, neutron and x, 20: 18548
strontium-85 body burdens in, effects of sodium salicylates on, 20: 18229
strontium-90 metabolism in, after intraperitoneal or subcutaneous injection, 20: 18225

MICROORGANISMS
biological activity and nature of scrapie agent, 20: 18314
desoxyribonucleic acid synthesis in *Stentor coeruleus*, cytoplasmic control of, 20: 18295(R) (UCLA-12-576, pp 27-56)
detection in extraterrestrial environments, 20: 18187(R) (N-65-16497)
radiosensitivity of scrapie agent, use in size estimations, 20: 18314
responses of test, research on, 20: 18187(R) (N-65-16497)

MICROSCOPES
design for examination of metal surfaces immersed in liquid helium, 20: 19732

MICROSOMES
electrophoresis of, 20: 18205(R) (LA-3432, pp 178-262)

MICROWAVE EQUIPMENT
wave splitting in plasma-filled waveguides, (T), 20: 19300 (N-65-23065)

MICROWAVE SPECTROMETERS
performance for time-resolved electron density measurement in plasma afterglows, 20: 20054

MICROWAVES
amplification in cesium and mercury plasmas, 20: 20052
emission from PIG reflex discharge plasma, (E), 20: 20082
interactions with energetic free electrons at cyclotron resonance, quantum mechanical properties of, 20: 19462
reflection and transmission by thin superconducting films, 20: 19772
scattering by plasma, magneto-Kerr effect in, (E/T), 20: 20014 (NP-15938)
scattering by plasma for electron density determination, 20: 20022
scattering by turbulent helium plasma in magnetic fields, (E), 20: 20039
use in plasma diagnostics, method of, 20: 20012 (N-65-27813)

MILITARY PERSONNEL
radiation protection of, medical facilities at San Piero for, 20: 18963

MILK
cesium-137 contamination in, uptake by man of, 20: 18220
iodine-131 contamination in Italian, radiation dose to children's thyroid from, 20: 18962
iodine-131 content in, following accidents at nuclear facilities, 20: 18983
iodine-131 content in, effects of forage contamination on, 20: 18941(R) (IDO-12047)
radioactive contamination in, survey, 20: 18976
radioactive contamination of, methods for removing, 20: 18976

radioactivity after nuclear accidents, 20: 18969
radioactivity in, 1965, 20: 18914
radioactivity in, 1965, 20: 18915
radioactivity in, 1965, 20: 18918
radioactivity in, Jan. to July, 1965, 20: 18972
radionuclide levels in, measure for moderating, 20: 18985
strontium-90 content in Californian, 1960 to 1963, 20: 18968
strontium-90 in, effects of physico-chemical state on rat uptake of, 20: 18224

MINERALOGY
geologic studies on, in western United States, 20: 18942(R) (NYO-1669-11)

MINING
pillar-model tests in salt mines, 20: 18897 (ORNL-P-2006)

MITOCHONDRIA
cholesterol and sodium octanoate oxidation by rat liver, effects of water-d_2 on, 20: 18217
effects of disulfides and thiols on, biochemical, 20: 18453

MITOSIS
effects on nucleic acid synthesis in mammalian cells in culture, 20: 18204(R) (LA-3432, pp 130-77)
effects on protein synthesis in mammalian cells in culture, 20: 18204(R) (LA-3432, pp 130-77)
radiation effects on rat marrow, protective effects of sodium against x, 20: 18326
radiation effects on, in spermatogenesis of *Drosophila melanogaster*, 20: 18354
radiation effects on animal cells during interphase, x, 20: 18430
radiation effects on mouse, protective effects of intestinal shielding against x, 20: 18432
radiation effects on turtle, gamma, 20: 18291(R) (N-65-17058)
radiation effects on, in regenerating rat liver, x, 20: 18457
radioinduced reversion in, giant cell production by x, 20: 18325

MIXER-SETTLERS
performance in Thorex Process, 20: 18823 (DP-1022)

MOLECULAR BEAMS
reactions with ion beams at low energies, absolute cross sections for charge transfer, (E), 20: 19670

MOLECULAR WEIGHTS
radiation effects on deoxyribonucleohistone, 20: 18789

MOLECULES
diffusion in solid organic compounds, tracer studies of, 20: 18673
electron capture by, (E/T), 20: 18557 (ORNL-TM-1409)
ion reactions with, energy transfer in, 20: 18556(R) (BNL-929, pp 66-82)
motion in compounds, study by neutron transmission, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
motion of, in solids, review of NMR studies of, 20: 18672
neutron scattering by, thermal, (T), 20: 19800
neutron scattering by, review on, (E), 20: 19801
nuclear magnetic relaxation of many-spin system of, (T), 20: 20116
physical chemistry of macro-, 20: 18184(R) (BNL-929, pp 115-25)
preparation of labeled, survey of SORIN, 20: 18804 (SORIN-34)
radiation effects on collagen, uv, 20: 18252
radiolysis of gaseous, ion yields and dose partition in, 20: 18754
role in radiation injuries of biological systems, 20: 18274
spectra of, isotope effects on vibrational transition probabilities in, 20: 18639

MOLLUSKS
age estimation of, from raised marine terraces by thorium-230/uranium-234 method, 20: 18925 (NYO-3450-1, pp 1-27)
strontium-90 uptake by marine, correlation with buildup factor, 20: 18215

MOLYBDENUM
annealing of, tracer studies of grain boundary migration in, 20: 19251
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
internal friction in deformed, 20: 19250
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
separation from technetium by sorption by charcoal or coal, 20: 18830
spallation by protons at 340 Mev, separation of technetium from products from, 20: 18843
thermodynamic properties at high temperatures and pressures, 20: 19217 (NP-15933)

MOLYBDENUM ALLOYS
Mo–Nb–V–Zr, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Mo–Re, internal friction in deformed, 20: 19250
Mo–Ti–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on TZM, 20: 18567 (MAB-217-M)
Mo–Zr, annealing of, tracer studies of grain boundary migration in, 20: 19251
Mo–Zr, internal friction in deformed, 20: 19250

MOLYBDENUM BORIDES
preparation by carbon reduction of boric oxide and molybdenum oxide, 20: 18702

MOLYBDENUM FLUORIDES
thermodynamic properties at 4 to 350°K, 20: 18669

MOLYBDENUM ISOTOPES Mo-96
x-ray spectra of, muon-capture-induced, (E), 20: 19273(R) (BNL-929, pp 3-43)

MOLYBDENUM ISOTOPES Mo-98
x-ray spectra of, muon-capture-induced, (E), 20: 19273(R) (BNL-929, pp 3-43)

MOLYBDENUM ISOTOPES Mo-99
determination by autoradiographic measurement of half life using ring oven methods, 20: 18584
differentiation from technetium-99 in rabbits, effects on gamma counting rate of, 20: 18213
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583

MOLYBDENUM NITRIDES
preparation of single-crystal, 20: 18556(R) (BNL-929, pp 66-82)

MOLYBDENUM OXIDES
reactions with boric oxide and carbon to prepare molybdenum boride, 20: 18702

MOLYBDENUM STEEL
Cr–Mo, corrosion of Croloy 9M, by mercury at 1074°F, 20: 19189 (N-65-21161)
Cr–Mo, diffusion of carbon from Croloy 9M, to type 316 stainless steel in composite tubing, 20: 19189 (N-65-21161)
Mn–Mo, mechanical properties of A302-B, effects of cold-working and heat treatments on, 20: 19205(R) (GA-6923)
Mn–Mo, radiation effects on mechanical properties of SA302B, fast-neutron, 20: 19178(R) (IDO-17154)
Mn–Mo–Ni–Nb, radiation effects on mechanical properties of low-alloy, neutron, 20: 19258 (UJV-1470/65)

MOLYBDENUM SYSTEMS
Fe–Mo–N, preparation of kryptonates of Moly-Perma-Foil by diffusion, 20: 18570(R) (NYO-2757-5)

MONAZITES
effects on *Phaseolus vulgaris*, 20: 18237

MONEL
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)

MONKEYS
anesthetic for, use of phencyclidine hydrochloride as, 20: 18289(R) (LA-3432, pp 56-101)
atherosclerosis development in, effects of chondroitin sulfate on, 20: 18295(R) (UCLA-12-576, pp 27-56)
effects of nitrogen mustard on, effects of thioglycollic acid derivatives on toxic, 20: 18474
radiation effects on conditioned and avoidance behavior of, γ, 20: 18283 (AD-611869, pp 375-89)
tooth extraction techniques for, 20: 18289(R) (LA-3432, pp 56-101)

MONOCHROMATORS
design of gamma, 20: 20177(R) (BNL-929, pp 83-105)
design of high intensity uv, 20: 19011

MONTE CARLO METHOD
use for reactor perturbation calculations, 20: 20196 (AEEW-M-581)
use in calculation of intranuclear cascades, 20: 18556(R) (BNL-929, pp 66-82)
use in calculation of thermal-neutron fluxes, computer programs for, 20: 19786 (WAPD-T-1835(Rev.))

MONTMORILLONITES
sorptive properties for manganese-54 and zinc-65 in sea water, 20: 18576(R) (TID-22660)

MOON
electric power systems for use on, status of radioisotope-fueled, 20: 19132 (N-65-24571)
magnetic fields of, from trapped solar plasma stream, 20: 19328 (NP-15939)

MORPHINES
radiosensitivity effects in mice, 20: 18459

MOSQUITOES
radiation effects on respiration in eggs of Bombyx, x, 20: 18301

MÖSSBAUER EFFECT
detection of, spectrometer for, 20: 19050
gamma relaxation narrowing in, (T), 20: 20153
use in narrow-angle multiple-scattering measurements for inhomogeneous materials at 14.4 kev, (E), 20: 19904
uses in studies of metals, 20: 20162

MOUND LAB., MIAMISBURG, OHIO
environs monitoring, July through Dec., 1964, 20: 18972

MOUTH

radioinduced infections in, 20: 18308
radiosensitivity of, 20: 18308
radiotherapy of tumors of, late pathological effects, 20: 18523
MULTIPLICATION FACTOR
calculation for water-moderated aluminum–plutonium and plutonium dioxide–uranium dioxide lattices, 20: 20200(R) (ANL-7110, pp 29-98)
optimization for natural uranium–graphite reactors, 20: 20217
MUSCLES
analysis of, by activation methods, Szilard-Chalmers effect in, 20: 18583
insulin binding to striated, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on physiology of, γ and x, 20: 18293 (NP-14898)
radiation effects on excised diaphragm-nerve preparations, 20: 18293 (NP-14898)
radiation effects on contraction of, effects of ion content and fluxes on, 20: 18293 (NP-14898)
relaxation after ATP-induced contractior in rabbit psoas, effects of deuterium oxide on, 20: 18228
MUTATIONS
radiation effects on plants, 20: 20360(R) (PRNC-73)
radioinduced dominant lethal, in mouse spermatozoa, effects of dose on x, 20: 18351
radioinduced in barley seed, x, 20: 18411
radioinduced in barley, use in plant breeding programs of x, 20: 18418
radioinduced in beans and soybeans, use in plant breeding programs, 20: 18419
radioinduced in Drosophila, β, γ, and x, 20: 18332
radioinduced in Drosophila, 20: 18333
radioinduced in Drosophila sperm, x, 20: 18336
radioinduced in *jute corchorus olitorius*, 20: 18385
radioinduced in maize pollen mother cells, γ, 20: 18335
radioinduced in maize endosperm, frequency of γ, light, and uv, 20: 18392
radioinduced in mice, effects of time between irradiation and conception on frequency of fission-neutron, 20: 18368
radioinduced in Neurospora, uv, 20: 18196
radioinduced in oats, neutron, 20: 18417
radioinduced in Paramecium, temperature-sensitive x, 20: 18348
radioinduced in Paramecium, conditions affecting yield of temperature-sensitive x, 20: 18349
radioinduced in rice, x, 20: 18414
radioinduced in rice, use in plant breeding programs, 20: 18416
radioinduced in rice, γ, 20: 18417
radioinduced in Saccharomyces, 20: 18405
radioinduced in tomato pollen, factors affecting frequency of γ, 20: 18393
radioinduced in yeast, genetic studies of uv and x, 20: 18190(R) (UCRL-16613)
radioinduced polygenic, in *Drosophila melanogaster*, x, 20: 18415
radioinduced somatic, in trees, γ, 20: 18421
radioinduced wheat, use in breeding program, 20: 18322
radioinduced, use in field crop breeding programs, 20: 18420
use of radio- and chemically induced, in Neurospora, 20: 18347
MYOSINS
radiation effects on, protective effects of ATP against γ, 20: 18259
reactions with β-hydroxyethyl-2,4-dinitrophenyl disulfide, 20: 18722

N

NAPHTHALENE
effects on radiolytic isomerization of stilbene in benzene solutions, 20: 18735
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
x-ray scattering by, Raman lines in, (E), 20: 18559 (CALT-221-14)
NAPHTHALENE, 1,2,3,4-TETRAHYDRO-
radiolysis of, excited and superexcited states in, 20: 18783
1,4-NAPHTHALENEDIOL, 2-METHYL- DIPHOSPHATE, SODIUM SALTS
effects on phosphorus-32 uptake by irradiated rats, 20: 18379
preparation of tritiated derivatives of, for use as drugs, 20: 18464
radiosensitivity effects on tumors, 20: 18464
radiosensitivity effects on rat tumors, 20: 18533
1,4-NAPHTHOQUINONE, 2-METHYL-
labeling with tritium in presence of tritiated water, 20: 18711
NEODYMIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
determination in nitrate solutions by conductometric titration using sodium tungstate, 20: 18608
separation from praseodymium by solvent extraction using organic phosphorus compounds, 20: 18850
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
NEODYMIUM ALLOYS
Ge–Nd, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Nd, preparation and crystal of NdGe, 20: 19224
NEODYMIUM CHLORIDES
magnetic phases, (T), 20: 20143
spectra of single crystals of, exchange coupling in high-resolution absorption, (E), 20: 20140
NEODYMIUM COMPLEXES
with EDTA, thermal properties of, 20: 18679
NEODYMIUM ETHYL SULFATES
rare earth ion orientation in, quadrupole coupling constants from, (E), 20: 20146
NEODYMIUM ISOTOPES Nd-144
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
NEODYMIUM ISOTOPES Nd-146
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
NEODYMIUM ISOTOPES Nd-148
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
NEODYMIUM ISOTOPES Nd-150
energy levels of, high-spin rotational, (E/T), 20: 19953
NEODYMIUM OXALATES
thermal decomposition of, changes in surface areas of products from, 20: 18680
NEODYMIUM OXIDES
production by thermal decomposition of neodymium oxalate, conditions for optimum surface areas in, 20: 18680
NEODYMIUM SILICIDES
preparation and crystal structure of, 20: 19224
NEON
electron binding energy of, K-shell, (E), 20: 19405
electron distribution in, solution of Thomas-Fermi-Dirac equation for, 20: 19366
electron spectra of, KLL and KL-LLL Auger, (E), 20: 19405
helium-ion elastic scattering at 10 to 600 ev, cross sections for, (E), 20: 19392
ion and light emission from plasma of, time dependence of, (E), 20: 19995(R) (AD-630123)
ionization equilibria in sun, (T), 20: 19338
ionization striation production in hollow-cathode plasma of, (E), 20: 20085
properties of h-f discharge plasma of, magnetic-field effects on, (E), 20: 20087
sound propagation in afterglow plasma of, Tonks-Dattner resonance determination of, (E), 20: 20044
thermal conductivity of liquid, 20: 19614 (N-65-17283)
NEON IONS
sputtering reactions on oriental gold foils at 50 kev, (E), 20: 19372
NEON ISOTOPES Ne-20
alpha decay of excited, levels and spins from angular correlations from, (E), 20: 19913
energy levels, (T), 20: 19984
energy levels from carbon-12 (C-12,α) reactions, 8+, (E), 20: 19913
production in alpha reactions (α,t) with fluorine-19 at 28.6 Mev, level population in, (E), 20: 19876
NEON ISOTOPES Ne-21
energy levels from oxygen-18 (α,n) reactions, triplet, (E), 20: 19909
production in alpha reactions (α,d) with fluorine-21 at 28.6 Mev, level population in, (E), 20: 19876
NEON ISOTOPES Ne-22
energy levels from fluorine-19 (α,p) reactions, parity, spin, and widths of, (E), 20: 19938
NEON ISOTOPES Ne-23
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
NEON ISOTOPES Ne-24
yields from high-energy proton reactions, 20: 18556(R) (BNL-929, pp 66-82)
NEON SYSTEMS
Ar–He–Ne, striation production in hollow-cathode plasma at, (E), 20: 20085
NEPTUNIUM
preparation of thick and thin sources of, by electroplating and electrophoresis, 20: 18562(R) (EUR-2640.e)
separation from fission products using focusing chromatography, 20: 18601
NEPTUNIUM ISOTOPES Np-237
neutron reactions with, plutonium-238 production in, 20: 19134 (DUN-SA-5)
NEPTUNIUM ISOTOPES Np-239

dosimetry of, equation for internal, 20: 18955

NERVES
radiation effects on excised diaphragm-nerve preparations, 20: 18293 (NP-14898)

NERVOUS SYSTEM
radiation effects combined with labyrinthectomy on rabbit, γ, 20: 18338
radiation effects on mouse and rat, γ, 20: 18376
radiation effects on cat and rat central, x, 20: 18292(R) (N-65-17068)
radiosensitivity effects of drug depression or stimulation of mouse, 20: 18459

NEUROSPORA
leucine biosynthesis in, genetic regulation of enzymes for, 20: 18196
mutations in, utilization of chemically induced, 20: 18347
radioinduced mutations in, utilization of, 20: 18347
radioinduced mutations in, uv, 20: 18196
radiosensitivity of, effects of developmental stage on, 20: 18297(R) (UCLA-12-576, pp 81-8)

NEUTRINOS
bibliography, 20: 19445 (NEIC-RR-20)
detection and measurement of solar, 20: 20365
detection of cosmic, equipment for, 20: 20365
detection of solar, experiment for, 20: 18556(R) (BNL-929, pp 66-82)
existence of, review of evidence for, 20: 19517
interactions at high energies, semileptonic, (T), 20: 19527
interactions of, review, (E), 20: 19439 (ANL-7130, pp 273-84)
interactions with neutrons, meson (π) production cross sections for, (E), 20: 19438 (ANL-7130, pp 257-71)
interactions with electrons and positrons, two- and four-component theories in, 20: 19463
interactions with electrons, polarization in, (T), 20: 19464
interactions with nucleons, asymmetries in meson (π) production in, 20: 19478
motion in superdence matter, partial external trajectories of, (T), 20: 19446 (NP-15932)

NEUTRON BEAMS
effects on tissues, biological, 20: 18548
production of monochromatic, from 50 to 150 Mev, 20: 19789
uses in determination of moisture content of soils, 20: 19118

NEUTRON CAPTURE CROSS SECTIONS
measurement techniques and resonance parameters from, 20: 19812 (GA-6919)

NEUTRON CROSS SECTIONS
calculation of multigroup, computer program for, 20: 20201(R) (ANL-7110, pp 311-401)
calculation of thermal, computer programs for, 20: 19844 (WANL-TME-1228)
calculation of, optical model for, 20: 20183
compilations of, status of, 20: 20177(R) (BNL-929, pp 83-105)
library of multithermal, for reactor materials, 20: 19844 (WANL-TME-1228)
preparation for calculations on fast reactors, 20: 20229(R) (ANL-7110, pp 99-229)

NEUTRON-DIFFRACTION ANALYSIS
crystals for, design of, 20: 19769

NEUTRON RESONANCE CROSS SECTIONS
calculation of, methods development for, 20: 20201(R) (ANL-7110, pp 311-401)

NEUTRON SHIELDING
capture and scattering in, (T), 20: 20103

NEUTRON SOURCES
design of portable water-cooled water-reflected critical assembly, 20: 19782 (LA-3374)
neutron spectra from americium–lithium, 20: 20201(R) (ANL-7110, pp 311-401)
performance of beryllium–plutonium, 20: 18568(R) (NBL-230)
production and industrial uses of, conference on, 20: 19128
survey on thermal, 20: 19796

NEUTRON SPECTRA
measurement by modulation of target potential, 20: 19890
measurement in heterogeneous assemblies, techniques for, 20: 19778(R) (GA-6824)
measurement of thermal, by neutron activation, 20: 20200(R) (ANL-7110, pp 29-98)
measurement of, from americium–lithium sources, 20: 20201(R) (ANL-7110, pp 311-401)
shape analysis of time-of-flight, computer program for, 20: 19833 (RT/FI-(65)48)

NEUTRON SPECTROMETERS
data corrections for helium-3, computer program for, 20: 19047 (UCRL-16595)
design and performance of helium-3, 20: 19047 (UCRL-16595)
design of proton-recoil, using semiconductor detectors, 20: 19018(R) (ANL-7110, pp 231-310)
performance of time-of-flight, with semiconductor time-to-amplitude converter, 20: 19071
survey, 20: 19794
survey on crystal, 20: 19795

NEUTRON SPECTROSCOPY
method for fast, scintillation, 20: 19790
use in kinetics and structure determinations in liquids and solids, 20: 20164

NEUTRON TOTAL CROSS SECTIONS
measurements of fast, 20: 19805(R) (ANL-7110, pp 1-28)

NEUTRONS
absorption by nuclei, resonance parameters of, 20: 19812 (GA-6919)
bound states of, three-body, (T), 20: 19501
buckling in graphite moderated plutonia-urania assemblies, 20: 20197 (AEEW-R-438)
buckling in graphite lattices fueled with plutonium and uranium dioxides, (E), 20: 20198 (AEEW-R-464)
buckling in graphite lattices fueled with plutonium and uranium dioxides, (T), 20: 20199 (AEEW-R-466)
capture by boron-10 in cell mixtures, local effects of, 20: 20360(R) (PRNC-73)
capture by gadolinium-156, cross sections for, (E), 20: 19835 (SGAE-PH-35/1965)
capture by nuclei $23 \leq Z \leq 27$ at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
decay of, equal-time axial-vector current commutators in sum rules for, (T), 20: 19511
decay of, renormalization axial-vector coupling constants for, (T), 20: 19808 (ANL-7130, pp 409-20)
density in time-dependent media, 20: 19788
detection and measurement of, performance of ionization chambers and proportional counters for, 20: 19047 (UCRL-16595)
diffraction of, doubly curved guide for suppression of higher orders in, 20: 19787
diffusion calculations, computer program for one-dimensional, 20: 20201(R) (ANL-7110, pp 311-401)
diffusion equations for reactors, computer program for solving, 20: 20207 (ORNL-TM-1302)
diffusion equation for, computer program for solution of one-dimensional multigroup, 20: 19777 (CEA-R-2923)
diffusion in parallel-slab subcritical assemblies, 20: 20195 (AAEC/TM-302)
effects on aluminum oxides, EPR studies of, 20: 18740
effects on bcc metals, annealing of, 20: 19267
effects on bcc metals, 20: 20183
effects on burros, pathological, 20: 18188(R) (ORO-635)
effects on cattle, pathological, 20: 18188(R) (ORO-635)
effects on cobalt complexes on ion exchanger, 20: 18764
effects on copper strength, 20: 20365
effects on crystal structure of aluminum and aluminum alloys at −196°C, 20: 19260
effects on dimensions of aluminum–uranium compound-dispersion fuels, 20: 19178(R) (IDO-17154)
effects on DNAase activity in rat urine, 20: 18262
effects on electronic components, 20: 19098(R) (N-65-17953)
effects on electronic components, research program on, 20: 19107(R) (N-65-21263)
effects on Ferrovac E, 20: 20177(R) (BNL-929, pp 83-105)
effects on graphitized carbon black, temperature dependence of ESR from, (E), 20: 20144
effects on mechanical properties of low-alloy manganese–molybdenum–nickel–niobium steel, 20: 19258 (UJV-1470/65)
effects on microcircuit digital gates, 20: 19100 (N-65-18004)
effects on oats, genetic, 20: 18417
effects on plants, genetic, 20: 18420
effects on plants, genetic, 20: 18188(R) (ORO-635)
effects on sheep, pathological, 20: 18188(R) (ORO-635)
effects on swine, pathological, 20: 18188(R) (ORO-635)
effects on tantalum, effect of oxygen concentration on annealing of, 20: 19268
effects on thermal cracking of petroleum gas-oil fractions, 20: 18785(T)
effects on tritium gas bubble formation in aluminum–lithium alloys, (E), 20: 19265
flux attenuation in KS-150 reactor shielding, 20: 20269 (UJV-1454/65)
flux beneath shield of meson production facility, (T), 20: 20100 (ORNL-TM-1423)
flux distribution in exponential assemblies, (E/T), 20: 20214
flux distribution in multilayer unit cells, method for measuring, (E), 20: 20204 (INR-656/IX-A/R)
flux measurement in reactors, method for direct, 20: 20213
flux monitoring in reactors using argon, 20: 20206 (NAA-SR-11356)
fluxes in unpoisoned assemblies, measurement of, 20: 20183
form factor relation to separate-singlet vector-meson coupling in U(6),

$\omega\phi$ mass difference for electric, 20: 19572
form factors of, from deuteron–electron interactions, (E), 20: 19509
interactions with deuterons, review of, 20: 19982
interactions with protons, charge exchange model for, 20: 19273(R) (BNL-929, pp 3-43)
interactions with mesons (π) at 1.7 Bev/c, products from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with neutrinos, meson (π) production cross sections for, (E), 20: 19438 (ANL-7130, pp 257-71)
interactions with protons at 205 Mev, polarization parameters of, (E), 20: 19453 (UR-875-126, Paper 5)
interactions with protons at 605 Mev, elastic, (E), 20: 19441 (JINR-E-2560)
interactions with protons at 23.1 Mev, phase shift analysis for, (E), 20: 19442 (JINR-E-2609)
interactions with protons, amplitude for elastic, (T), 20: 19504
interactions with mesons (π^+), Regge-pole analysis of meson (ω) production in, (T), 20: 19510
interactions with protons, 2^+ meson exchange in, (T), 20: 19512
kinetics in reactors, computer program for, 20: 20202 (AWRE-O-4/66)
mass relative to protons, (T), 20: 19508
multiplication factor in natural-uranium–graphite reactors, optimization of, 20: 20217
multiplication in fissionable materials, theory of first-passage distributions for, 20: 20101
polarization by scattering, (E/T), 20: 20365
production in heavy water reactors, methods for high-flux, 20: 20183
production using accelerators, targets for, 20: 19296 (EUR-2641.d,f,e)
reaction cross sections and scattering experiments at FRM, 20: 20331
reactions (n,α), (n,2n), and (n,p) with nuclei at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
reactions (n,α) with lithium-6, tritium production in, 20: 18763
reactions (n,α) with argon-40 at 14.1 Mev, alpha angular and energy distributions from, (E), 20: 19853
reactions (n,γ) with silicon-28, silicon-29 levels from, (E), 20: 19846
reactions (n,γ) and (n,n′) with gold-197 and rhodium-103, resonances in, (E), 20: 19866
reactions (n,p) with silicon-28 at 9.1 to 21 Mev, angular distributions from, (E/T), 20: 19813 (IKF-14)
reactions (n,p) with tin isotopes at 14 Mev, cross sections for production of isomeric indium isotopes from, (E), 20: 19939
reactions (n,2n) with calcium-48, effective cross sections for, 20: 19943
reactions with aluminum halides to produce krypton and xenon isotopes, 20: 18731
reactions with plutonium-239 to 200 ev, resonance parameters in, (E), 20: 19856
scattering by carbon-12 and oxygen-16 at 14.1 Mev, gamma emission in, (E), 20: 19817 (INR-661/IA/PL)
scattering by cobalt, temperature dependence of amplitudes for magnetic, 20: 20335
scattering by copper, potentials from second-order multiple scattering theory elastic, 20: 19933
scattering by deuterium at 3.8 and 4.6 Mev, polarization in elastic, (E), 20: 19870
scattering by hydrogenous reactor moderators, reaction rate curves for, (E/T), 20: 19776 (AE-223)
scattering by liquids, review on, (E), 20: 19799
scattering by liquids and solids, elastic and inelastic nuclear and magnetic, 20: 20164
scattering by liquids, kinetics studies using, 20: 19620
scattering by magnetic materials, survey on, 20: 19797
scattering by molecules, (T), 20: 19800
scattering by molecules, review on, (E), 20: 19801
scattering by molecular crystals, elastic and inelastic magnetic, 20: 20165
scattering by nuclei at 84 to 350 Mev, differential cross sections and polarization from second-order multiple scattering theory elastic, 20: 19933
scattering by plutonium-239 and uranium-233 and -235, amplitudes for coherent, (T), 20: 19845
scattering by potassium manganese fluorides, diffuse, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
scattering by reactor moderators, cross sections for, (E/T), 20: 19778(R) (GA-6824)
scattering by solids, measurement of molecular motions by, 20: 18674
scattering in ferromagnetic crystals containing impurities, inelastic, (T), 20: 20158
scattering of 14-Mev, performance of time-of-flight spectrometer for angular distribution measurement from, 20: 19071
scattering of, numerical analysis of critical magnetic, 20: 19785 (RISO-118)
scattering of, research on inelastic, 20: 20183
scattering resonances, 20: 20201(R) (ANL-7110, pp 311-401)
slowing down in reactors, transfer matrices for, (T), 20: 19784 (NAA-SR-11530)
slowing down of, transfer matrices for multigroup, (T), 20: 19784 (NAA-SR-11530)
spectra measuring methods for, 20: 20183
strength functions of, level spin dependence of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
thermalization in reactor moderators, review of integral, 20: 19779 (GA-8904)
thermalization of, integral, (E/T), 20: 19778(R) (GA-6824)
transport equation for, computer program for solution of one-dimensional multigroup, 20: 19783 (NAA-SR-10951)
transport theory for, exponential transform for, 20: 20099 (ORNL-RSIC-14)

NEUTRONS, COLD
scattering by hydrides, determination of localized modes of hydrogen excess in, (E), 20: 20107 (EUR-2734.e)

NEUTRONS, DELAYED
emission by antimony and arsenic isotopes, 20: 18838
kinetics in highly enriched heavy water reactors, (E), 20: 20209 (TID-22730)

NEUTRONS, EPITHERMAL
dosimetry in phantoms, 20: 18185(R) (BNL-929, pp 126-47)
use in well logging, analytical theory for, 20: 18932

NEUTRONS, FAST
attenuation in iron surrounding cylindrical ducts, (E/T), 20: 20092 (AE-220)
capture by yttrium-89, isomer ratios from, (T), 20: 19920
cross sections in elements, method of determining, 20: 20183
detection of, methods development for, 20: 19018(R) (ANL-7110, pp 231-310)
effects on agricultural plants, 20: 18409
effects on barley chromosomes, effects of dose on aberrant, 20: 18355
effects on cardiac function, 20: 18328
effects on content of steroids in blood of burros, 20: 18296(R) (UCLA-12-576, pp 57-60)
effects on dimensions of graphite, effects of carbon black content on, 20: 19252 (BNWL-201)
effects on mechanical properties of SA212B and SA302B steels, 20: 19178(R) (IDO-17154)
effects on mechanical properties of beryllium, 20: 19178(R) (IDO-17154)
effects on oxygen chemisorption by calcia and magnesia, 20: 18787
effects on rabbit eyes, effects of chemical radioprotective compounds on, 20: 18476
effects on silica gels, x-ray scattering studies on, 20: 19254 (CONF-650629-3)
effects on tissues, biological, 20: 18548
polarization of, formalism for numerical evaluation of, 20: 19791
reactions (n,α), (n,2n), (n,np), (n,p) and (n,t) with nuclei below 20 Mev, excitation functions for, (E/T), 20: 19883
reactions (n,f) with uranium-235, (E), 20: 19805(R) (ANL-7110, pp 1-28)
reactions (n,f) with uranium at 14 Mev, alpha and fission-fragment angular distributions from, (E), 20: 19861
reactions (n,f) with uranium-235 at 0.36 to 0.65 Mev, cross section for, 20: 19935
scattering by elements, elastic and inelastic, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
scattering by uranium-235 at 0.4 to 0.6 Mev, cross sections for elastic, (E), 20: 19935
spectroscopy of, scintillation method for, 20: 19790

NEUTRONS, FISSION
effects on mouse offspring, effects of time between irradiation and conception on frequency of mutagenic, 20: 18368
spectra of low-energy, measurement of, 20: 19018(R) (ANL-7110, pp 231-310)

NEUTRONS, THERMAL
book: *Thermal Neutron Scattering*, 20: 19792
capture by titanium-48, nuclear-force time-reversal invariance determination from cascade from polarized, (E), 20: 19906
detection of, survey of instruments for, 20: 19796
effects on krypton trapping by uranium carbide surfaces, 20: 19255 (EUR-2749.e)
flux calculations using Monte Carlo method, computer programs for, 20: 19786 (WAPD-T-1835(Rev.))
measurement in soil–water systems, scintillation detector for, 20: 19092
reactions (n,γ) with nuclei, research at RC-1 reactor, 20: 20334
reactions (n,γ) with vanadium-51, vanadium-52 level scheme from, (E), 20: 19899
reactions with gold, activity from, (T), 20: 19834 (SGAE-CH-24/1965)
reactions with gold, gold-198 yields from, (E), 20: 19878
scattering by crystals, structure analysis using inelastic, 20: 20170
scattering by hexamethylbenzene, studies of hindered rotational motions and phase transitions by, 20: 18717

scattering by liquids, 20: 19798
scattering by liquids, review on, (E), 20: 19799
scattering by magnetic materials, survey on, 20: 19797
scattering by molecules, (T), 20: 19800
scattering by molecules, review on, (E), 20: 19801
scattering by reactor moderators, computer program for, 20: 19780 (JAERI-1094)
scattering by reactor moderators, methods for calculating, (T), 20: 19781 (JAERI-1095)
scattering in liquids and solids, (T), 20: 19793
scattering of, crystal-diffraction techniques for inelastic, (E/T), 20: 19795
scattering of, mechanical and time-of-flight techniques for inelastic, 20: 19794
slowing down in fissionable materials and moderators, 20: 20183
spectra in plutonium dioxide–uranium dioxide lattices, measurement by neutron activation, 20: 20200(R) (ANL-7110, pp 29-98)
spectra in reactors, computer program for, 20: 20205 (JAERI-1097)
use in concrete moisture-content determination, 20: 18610
use in neutron capture therapy, 20: 18507 (BNL-10009)
use in neutron capture therapy, 20: 18508 (BNL-10038)

NEVADA TEST SITE
radiation effects on growth and morphology of plants at, 20: 18386
radiation effects on animal and plant ecology at, 20: 18211(R) (UCLA-12-576, pp 89-111)

NEW JERSEY
age estimation and paleography of sediments in Triassic Basin in, 20: 18924(R) (NYO-1669-11)

NEW YORK
geologic studies on intrusion and metamorphism in rocks in, 20: 18924(R) (NYO-1669-11)
health physics program in New York City, 20: 18966

NEW ZEALAND
sulfur isotope content in volcanic materials from, 20: 18909

NICHROME
oxidation of, use of krypton-85 for studying effects of creep on, 20: 18570(R) (NYO-2757-5)
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
reactions with Nichrome at 1093°C, 20: 19178(R) (IDO-17154)

NICKEL
abundance in solar atmosphere, (T), 20: 19332
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
corrosion by hydrofluoric acid–nitrogen oxide solutions, 20: 20177(R) (BNL-929, pp 83-105)
corrosion of, measurement of, by beta backscattering and x-ray induction, 20: 19196
determination in iron by bremsstrahlung activation method, 20: 18613
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
distribution in shallow marine environments, 20: 18895 (NYO-3450-1, pp 217-76)
preparation of kryptonated, by ion bombardment, 20: 18570(R) (NYO-2757-5)
reactions with uranium nitride at 600 to 1200°C, 20: 19187 (BMI-1760)
separation from rare earths by ion exchange chromatography, 20: 18827

NICKEL ALLOYS
corrosion of Monel, by hydrofluoric acid–nitrogen oxide solutions, 20: 20177(R) (BNL-929, pp 83-105)
Mn–Ni, magnetic structure of, from polarized neutron scattering, 20: 20335

NICKEL CHLORIDES
positron annihilation in, origin of second lifetime component from, (E), 20: 19486

NICKEL ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)

NICKEL ISOTOPES Ni-58
deuteron reactions (d,n), at 7.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
proton reactions (p,n) with, 202-kev level from, (E), 20: 19914

NICKEL ISOTOPES Ni-59
energy levels from proton reactions (p,d) with calcium-40 at 55 Mev, neutron-hole, (E), 20: 19877

NICKEL ISOTOPES Ni-60
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
proton reactions (p,d) at 55 Mev, angular distributions and spectroscopic factors from, (E), 20: 19877

NICKEL ISOTOPES Ni-61
energy levels of, structure from isomeric transition in, (T), 20: 19970
oxygen ion reactions at 25 Mev, Mössbauer spectra from, (E), 20: 19832 (ORNL-P-1966)

NICKEL NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)

NICKEL STEEL
Cr–Mn–Ni, mechanical properties of austenitic cast, at 2.5 to 4.5°K, 20: 19232
Mn–Mo–Ni–Nb, radiation effects on mechanical properties of low-alloy, neutron, 20: 19258 (UJV-1470/65)

NICOTINAMIDES
radiosensitivity effects on rat thymocyte nuclei, 20: 18455

NICOTINIC ACID
radiosensitivity effects on rabbit eyes, 20: 18476

NIOBIUM
corrosion of, measurement of, by beta backscattering and x-ray induction, 20: 19196
determination in uranium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
determination using *N*-benzoylphenylhydroxylamine, spectrophotometric, 20: 18586
diffusion in gamma-phase uranium, 20: 19175 (ANL-6568)
dislocation damping in superconducting, 20: 20113(R) (NYO-3001-1)
magnetic hysteresis loops in superconducting, intrinsic properties of, (E), 20: 19741
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
radiation effects on, annealing of neutron, 20: 19267
rolling in air and vacuum at 300 to 1300°C, 20: 19200
separation from zirconium by solvent extraction using benzoyltrifluoroacetone or trifluoroacetylacetone, 20: 18833
separation from zirconium by solvent extraction using 8-hydroxyquinaldoxime and caproix acid, 20: 18849
separation from zirconium by solvent extraction using *N*-benzoylphenylhydroxylamine, 20: 18586
specific heat of unannealed wires of, at low temperature in magnetic fields, 20: 19751
superconducting properties of thin films of, 20: 19723 (N-65-17508)
superconducting transition temperature of, pressure dependence of, (E), 20: 19762

NIOBIUM ALLOYS
Mo–Nb–V–Zr, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Nb–Sn, preparation of thin films of Nb_3Sn, 20: 19723 (N-65-17508)
Nb–Ta–W–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on FS-85, 20: 18567 (MAB-217-M)
Nb–V–Zr, development and properties of niobium-base Cb-753, 20: 19214 (N-65-22097)
Nb–Zr, corrosion of welded joints of, by water and steam, 20: 19195
Nb–Zr, magnetization of superconducting, effect of external current on, (E/T), 20: 19735
Nb–Zr, microstructure of cast, with low oxygen contents, 20: 19245
Nb–Zr, phase transformation in, start temperature for martensitic, 20: 19230
Nb–Zr, superconductivity of, effects of omega-transformation on, (E), 20: 19722 (N-65-17099)

NIOBIUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702

NIOBIUM CARBIDES
NbC–UC, vacuum emission of, 20: 19211(R) (N-65-21350)

NIOBIUM HYDRIDES
neutron inelastic scattering by, determination of localized modes of hydrogen excess in, (E), 20: 20107 (EUR-2734.e)

NIOBIUM ISOTOPES Nb-93
neutron inelastic scattering by, gamma emission in, 20: 19805(R) (ANL-7110, pp 1-28)

NIOBIUM ISOTOPES Nb-95
content in marine organisms in northeast Pacific Ocean, 20: 18903 (RLO-1750-3)
content in organisms and water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
content in Pacific Ocean surface water near mouth of Columbia River, 20: 18902 (RLO-1725-41)
content in Pacific Ocean sediments near mouth of Columbia River, 20: 18902 (RLO-1725-41)
distribution in sea water in Swordfish Program, 20: 18576(R) (TID-22660)

NIOBIUM STEEL
Mn–Mo–Ni–Nb, radiation effects on mechanical properties of low-alloy,

neutron, 20: 19258 (UJV-1470/65)
NITRATE IONS
effects on separation of americium from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
NITRATES
photolysis in acids, mechanisms of, 20: 20360(R) (PRNC-73)
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
radiolysis of, products of gamma, 20: 20360(R) (PRNC-73)
NITRIC ACID
dodecane–HNO_3–TBP–$UO_2(NO_3)_2$–H_2O, equilibrium relations for, for nitric acid-uranyl nitrate extraction, 20: 18844
dodecylamine–HNO_3 trioctylphosphine oxide, distributions coefficients for americium, curium, plutonium, and promethium ions in, 20: 18561 (EUR-2635.d)
F–HNO_3, solvent properties for thorium dioxide–uranium dioxide fuel particles, effects of metals and sulfate on, 20: 18819 (AAEC/E-143)
NITRITE IONS
production in NO+ in atmosphere, crossed molecular-ion beam interactions for absolute cross section for, (E), 20: 19670
NITRITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
NITRO COMPOUNDS
effects on iodine-131 exchange between iodine and 1-phenyl-2,3-dimethyl-iodopyrazolone, 20: 18690
electrochemical reduction of aliphatic, effects of dielectric constant of organic solvents on, 20: 18636(R) (TID-22725)
NITROGEN
content in Phaseolus, effects of rare earths on, 20: 18237
determination in presence of boron by proton activation, 20: 18582
effects on atomic hydrogen yields from low-pressure hydrogen discharge, 20: 18663
effects on boron determination by deuteron or proton activation, 20: 18582
electron transitions of isotopic diatomic molecules of, Franck-Condon factors for, 20: 18658
energy levels in, quasibound negative-ion ground-state, (E), 20: 19387
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
production of molecular ions in atmosphere, crossed molecular-ion beam interactions for absolute cross section for, (E), 20: 19670
proton reactions at 13 Mev, cross sections for, (E), 20: 19941
radiation effects on frog serum content, gamma, 20: 18243 (NIJS-R-454)
reactions with carbon at 4.2°K, 20: 18667
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
spectral-line profile in theta-pinch hydrogen plasma, (E), 20: 20061
thermal conductivity of liquid, 20: 19614 (N-65-17283)
NITROGEN ISOTOPES N-12
beta decay of, matrix elements for, 20: 19940
NITROGEN ISOTOPES N-13
use in medicine of cyclotron-produced, 20: 18515
NITROGEN ISOTOPES N-14
effects on Franck-Condon factors for electron transitions in nitrogen molecules, 20: 18658
reactions with cesium-133 at 140 Mev, cesium isotope production in, 20: 19927
scattering by nuclei, Coulomb excitation in inelastic, (E), 20: 19959
NITROGEN ISOTOPES N-15
effects on Franck-Condon factors for electron transitions in nitrogen molecules, 20: 18658
energy levels of, (E), 20: 19273(R) (BNL-929, pp 3-43)
proton reactions (p,α) at 6.70 to 15.16 Mev, cross sections for, (E), 20: 19818 (INSJ-95)
NITROGEN ISOTOPES N-17
production by proton reactions with target masses $20 \leq A \leq 240$, cross sections for, 20: 18556(R) (BNL-929, pp 66-82)
NITROGEN MUSTARDS
effects on growth of lymphoma cells in culture, tracer study, 20: 18462
effects on mice and monkeys, effects of thioglycollic acid derivatives on toxic, 20: 18474
effects on mice, effects of mycelia-derived nucleotides on, 20: 18452
NITROGEN OXIDES
decomposition of, catalytic effects of cobalt oxide on, 20: 20365
effects on gamma radiolysis of 2-propanol, 20: 18766
effects on gamma radiolysis of polypropylene, 20: 18770
quenching effects on positronium in organic liquids, kinetics of, 20: 18662
radioinduced production of, G-values for, 20: 20177(R) (BNL-929, pp 83-105)
radiosensitivity effects on *Bacillus megaterium* spores, 20: 18434
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
HF–N_2O_3, corrosive effects on Monel and nickel, 20: 20177(R) (BNL-929, pp 83-105)
NITROGEN SYSTEMS
chlorotrifluoromethane–N, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
Fe–Mo–N, preparation of kryptonates of Moly-Perma-Foil by diffusion, 20: 18570(R) (NYO-2757-5)
H–N, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)
NORTH AMERICA
fallout monitoring, 1965, 20: 18914
fallout monitoring, 1965, 20: 18915
fallout monitoring, 1965, 20: 18918
NOSE
iodine-131 content in, after thyroid cancer radiotherapy, 20: 18512
NRX REACTOR
use for electric power and water desalination, economics of, 20: 20290 (NP-15920)
NUCLEAR BATTERIES
development status of radioisotope-fueled, for use on lunar surface, 20: 19132 (N-65-24571)
NUCLEAR EMULSIONS
antiproton interactions with nucleons at 725 Mev/c in, particle distributions from, (E), 20: 19465
particle track intensification in, methods for, 20: 19026 (INSJ-94)
NUCLEAR ENGINEERING
engineering materials list, 20: 18854 (TID-4100(Suppl.32))
NUCLEAR MAGNETIC MOMENTS
effects on cross sections of pair photoproduction on nuclei, (T), 20: 19968
NUCLEAR MAGNETIC RESONANCE
measurement of, for studing molecular motions in solids, 20: 18672
relaxation times in gases, h-f modulation and saturated scattering for measuring, 20: 19869
NUCLEAR MATERIALS MANAGEMENT
conference on, Buffalo, New York, June 17 to 19, 1963, 20: 20366
methods for plutonium at Rocky Flats, Colo., 20: 18948 (RFP-720)
uranium determination for, review of methods for, 20: 18619
NUCLEAR MODELS
development for deformed nuclei, (T), 20: 19986
potential form in, self-consistent, 20: 19965
theory, 20: 19987
NUCLEAR MODELS (OPTICAL)
potential for alpha reactions with cobalt-59, (E/T), 20: 19815 (INP-440/PL)
use for analysis of elastic scattering and direct nuclear reactions, 20: 19989
NUCLEAR MODELS (SHELL)
deuteron wave function in, 20: 19273(R) (BNL-929, pp 3-43)
energy levels in, neutron single-particle, (T), 20: 19849
energy levels of two-dimensional nuclei in, 20: 19854
spatial symmetry in, jj-coupled wave-function classification from, (T), 20: 19932
NUCLEAR PHYSICS
bibliography on, 20: 19803 (AED-C-12-13(Pt.1))
bibliography on high-energy, 20: 19804 (AED-C-12-13(Pt.2))
book: *Nuclear Physics Detection Instruments and Their Application*, (In Chinese), 20: 19086
book: *Symmetry Groups in Nuclear and Particle Physics*, 20: 19591
conference, 20: 19980
data analysis systems using PDP-5 computers, 20: 19840 (UCRL-16723)
experiments in, for student use, 20: 19850
research, 20: 19811 (EUR-2465.i)
research at JEEP reactor facility, 20: 20332
theory of, elementary particle analogies in, 20: 19994
NUCLEAR POWER
development and uses in Soviet Union, 20: 20182(T) (AEC-tr-6700)
development status, 20: 20283
status, 20: 20282
use for industrial development, 20: 20363
use in space, hazards from, 20: 18949 (SC-DC-1369)
NUCLEAR POWER PLANTS
conference, 20: 20281
design of Dungeness B, 20: 20280
economic and technical appraisal of Dungeness B, 20: 20279
economics of dual-purpose desalination, 20: 20292
NUCLEAR REACTIONS
amplitudes of direct particle-redistribution, 20: 19974
analysis of elastic scattering and direct, optical model, 20: 19989
bibliography on, 20: 19803 (AED-C-12-13(Pt.1))
calculations on direct, 20: 19947
cross sections for photo-, methods for measuring, 20: 19991
cross sections of direct cluster-replacement, contribution of excited

states of virtual nucleus to, (T), 20: 19967
mechanisms of compound nucleus, (T), 20: 19988
reconstruction of, computer techniques for, 20: 19839 (UCRL-16478)
theory for direct, dispersion, 20: 19990
theory for, R- and S-matrix, 20: 19893
threshold effects in, research on, 20: 19802(R) (AD-630042)
uses of secondary, in radiochemistry, 20: 18807

NUCLEAR SPECTRA
interpretation using excitation modes, (T), 20: 19993

NUCLEAR STRUCTURE
analysis equations for, (T), 20: 19273(R) (BNL-929, pp 3-43)
bibliography on, 20: 19803 (AED-C-12-13(Pt.1))
conference on, 20: 19952
deformations in medium and heavy nuclei, (T), 20: 19986
energy levels of two-dimensional nuclei, 20: 19854
of beta-instability region nuclei, 20: 19884
research programs on, 20: 19273(R) (BNL-929, pp 3-43)

NUCLEAR THEORY
corrections for distorted-wave Born approximations, 20: 19273(R) (BNL-929, pp 3-43)
forces and zero-range saturation mixture in, particle-hole matrix elements for Wigner, 20: 19873
forces in, determination of, (T), 20: 19981
forces in, time-reversal invariance test for, (E), 20: 19906
potentials in, T matrix for screened Coulomb, 20: 19827 (N-65-21644)

NUCLEI
alpha inelastic scattering at 25 Mev, angular distributions from, (T), 20: 19816 (INP-441/PL)
beta decay of, isobaric spin conservation in, (T), 20: 19837 (UCRL-14750-T)
beta emission from, momenta dependence of helicity of, (E/T), 20: 19806 pp 313-25)
conference on spectra and structure of, 20: 19952
decay of deformed, electromagnetic, (E/T), 20: 20365
decay of, statistical distributions for, 20: 19851
decay properties of, use of isotope separator with synchrocyclotron for study of, 20: 19885
deformations in medium and heavy, (T), 20: 19986
deuteron reactions (d,p), amplitudes for, (T), 20: 19974
deuteron reactions (d,p) with, sensitivity to truncated potential, (T), 20: 19925
deuteron stripping reactions with, neutron single-particle states from, (T), 20: 19849
energy level excitation modes in, coupling of, (T), 20: 19993
energy level structure of even-even, collective, (T), 20: 19950
energy level transitions in odd, probabilities for E2 and M1, (T), 20: 19976
energy level transitions in deformed odd, probabilities for E2 and E3, (T), 20: 19824 (JINR-P-2540)
energy levels and pairing correlations in, band structure of, 20: 19855
energy levels of even-even, pair-correlation model for, 20: 19966
energy levels of even-even, E1 transitions from octupole, (T), 20: 19979
energy levels of even-even deformed, high-spin rotational, (E/T), 20: 19953
energy levels of odd deformed for $153 \leq A \leq 187$, structure of, (T), 20: 19821 (JINR-E-2561)
energy levels of rotational, analysis of low-lying, (T), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of two-dimensional, in shell model, 20: 19854
energy levels of, structure from isomeric transitions in, (T), 20: 19970
energy levels of, parity mixing in, (E), 20: 19836 (SGAE-PH-36/1965)
energy levels of, g-factor and lifetime determination of excited, (E), 20: 19846
energy levels of, measurement of widths of, 20: 19948
forces in, particle-hole matrix elements for Wigner and zero-range, 20: 19873
gamma absorption and scattering by, research at RC-1 reactor, 20: 20334
magnetic relaxation times in gases, h-f modulation and saturated scattering for measuring, 20: 19869
meson (μ) capture by, review on, 20: 19459
meson (π) capture by, two-nucleon emission from, (T), 20: 19843 (UR-875-126, Paper 2)
meson (π)–nucleon interactions in, elastic, (E/T), 20: 19444 (LYCEN-6527)
neutron reactions (n,γ) with, research at RC-1 reactor, 20: 20334
neutron reactions (n,α), (n,2n), (n,np), (n,p) and (n,t) below 20 Mev, excitations for fast, (E/T), 20: 19883
neutron resonance absorption by measurement of, cross sections for, 20: 19812 (GA-6919)
nucleon scattering by, high-energy approximation for nonlocal potentials in, 20: 19573
photodisintegration of mass-3, theoretical calculations on, 20: 19946
photon reactions with field of, nuclear magnetic effects on pair production in, (T), 20: 19968
photon reactions with, total absorption cross sections for, (T), 20: 19991
photoreactions on, giant resonances of, (E/T), 20: 20365
properties of deformed, 20: 20365
properties of, with velocity-dependent two-body potential, 20: 19874
proton reactions (p,n) with, charge exchange properties of, (E/T), 20: 19838 (UCRL-14760-T)
proton reactions (p,t) with, two-nucleon transfer theory for, 20: 19926
stretching deformed, centrifugal, (E/T), 20: 20365
structure of beta-unstable, 20: 19884
triton reactions (t,p) with, two-nucleon transfer theory for, 20: 19926
wave functions for medium and heavy, (T), 20: 19985

NUCLEI (CELLS)
effects of ploidy in guinea pigs, 20: 18260
effects of size of plant, on radiosensitivity of pollen, γ, 20: 18384
isolation from mammalian cells in tissue culture, 20: 18204(R) (LA-3432, pp 130-77)
nucleic acid synthesis in isolated, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
radiation effects on structure of rat thymocytes, x, 20: 18455
radiation effects on rat leukocyte, protective effects of B vitamins on beta, 20: 18499

NUCLEIC ACIDS
analysis of, chromatographic, 20: 18205(R) (LA-3432, pp 178-262)
metabolism of, 20: 18185(R) (BNL-929, pp 126-47)
photosensitization of, effects of furocoumarins on, 20: 18469
polymerization of, enzyme reactions for, 20: 18205(R) (LA-3432, pp 178-262)
synthesis in isolated nuclei from mammalian cells, tracer study, 20: 18204(R) (LA-3432, pp 130-77)

NUCLEONS
emission in meson (π^-) capture by nuclei $3 \leq Z \leq 13$, angular distributions from double, (E), 20: 19842 (UR-875-126, Paper 1)
emission in meson (π) capture by light nuclei, (T), 20: 19843 (UR-875-126, Paper 2)
form factors of, review on, 20: 19529
interactions in many-body systems of, (T), 20: 19274 (N-65-16830)
interactions in nuclei, velocity-dependent potential for, 20: 19874
interactions of boand, with mesons (π), elastic, (E/T), 20: 19444 (LYCEN-6527)
interactions of, methods for analyzing, (T), 20: 19981
interactions with photons, meson (π) production in, (T), 20: 19447 (UCRL-14614-T)
interactions with nucleons, review of, 20: 19454 (YALE-1807-33)
interactions with nucleons at 23.1 Mev, phase shift analysis for, (E), 20: 19442 (JINR-E-2609)
interactions with antiprotons in emulsions at 725 Mev/c, particle distributions from, (E), 20: 19465
interactions with mesons (π^-) at 17.2 Bev, mass distributions from, (T), 20: 19472
interactions with nucleons, p-wave analysis of N* and meson (π) production in, 20: 19476
interactions with nucleons, peripheral model for N* production in, 20: 19477
interactions with neutrinos, asymmetries in meson (π) production in, 20: 19478
interactions with mesons (π) at 300 to 700 Mev, absorption parameters and phase shifts for, (T), 20: 19481
interactions with hyperons (Λ), unitary symmetry for structure of weak, 20: 19489
interactions with mesons (π), dynamics with invariant collinear vertices, analyticity, and unitarity for low-energy strong, (T), 20: 19491
interactions with deuterons, asymmetry and multiple scattering in, (T), 20: 19492
interactions with photons, multipoles in meson (π^0) production from, (E/T), 20: 19493
interactions with mesons (ρ^0), total cross section for, 20: 19506
interactions with photons, T-invariance violations in, (T), 20: 19513
interactions with photons, isotopic relations for mesons (K) and (π) production amplitudes from, (T), 20: 19518
interactions with scalar and vector mesons, coupling constants for, (T), 20: 19521
interactions with mesons (π) at low energies, analysis using dispersion relations, (T), 20: 19522
interactions with neutrinos at high energies, semileptonic, (T), 20: 19527
interactions with mesons (π), SU(3) symmetry in bootstrap model for, 20: 19564
magnetic moment of, anomalous, (T), 20: 19525
model for, bootstrap with N*(1238) in self-consistent, 20: 19457
scattering by nucleons, theory of, 20: 20365
scattering by nuclei, high-energy approximation for nonlocal potentials in, 20: 19573
scattering of, theory of first-passage distributions for cascade, 20: 20101

NUCLEOPROTEINS
synthesis in normal and tumorous cells, 20: 18264
synthesis in normal and tumorous cells, 20: 18265
synthesis in normal and tumorous cells, 20: 18266
synthesis in normal and tumorous cells, 20: 18267
NUCLEOTIDES
analysis of, chromatographic, 20: 18205(R) (LA-3432, pp 178-262)
effects of mycelia-derived, on toxic effects of nitrogen mustard in mice, 20: 18452
polymerization of, enzyme reactions for, 20: 18205(R) (LA-3432, pp 178-262)
radiation chemistry of, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiation effects on magnetic resonance of, x, 20: 18274
NUCLEOTIDES, PYRIDINE DIPHOSPHATE
radiation effects on content of, in Ehrlich ascites carcinoma cells, x, 20: 18270
radiosensitivity effects in rats, 20: 18504
radiosensitivity effects in man and rats, 20: 18535
NUCLEOTIDES, PYRIDINE TRIPHOSPHATE
radiation effects on concentration of oxidized and reduced, in rat organs, 20: 18343
NUTRIENTS
distribution in Pacific Ocean near mouth of Columbia River, 20: 18902 (RLO-1725-41)

O

OAK RIDGE NATIONAL LAB., TENN.
analytical methods used at, master manual of, 20: 18574 (TID-7015 (Suppl.8))
indexes to master analytical manual 1953 through 1965, 20: 18575 (TID-7015(Indexes)(Rev.3))
OATS
radiation effects on, genetic neutrons, 20: 18417
radiosensitivity of, effects of genetic constitution on, 20: 18420
OCEANOGRAPHY
equipment and methods used in, description of, 20: 18633 (NYO-3450, pp 203-11)
marine geochemistry, conference on, 20: 18199 (NYO-3450-1)
radiation effects on marine life, 20: 18198
surveys by Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)
1-OCTENE
1-octene–2-propanol, radiolysis yields in, 20: 18730 (UJV-1468)
ODOR
radiation effects on papaya, γ, 20: 18247(R) (UH-235P5-1, pp 14-25)
OLEIC ACID
radiolysis of, γ, 20: 18210(R) (UCLA-12-576, pp 15-25)
ONIONS
use as radiation dosimeter during space flight, 20: 18964
ONTARIO
age estimation of micas and zircons in, by argon–potassium and uranium–lead methods, 20: 18929
OOCYTES
radiosensitivity of *Artemia salina*, effects of low temperature on x, 20: 18447
OOGENESIS
radiation effects on caterpillar, 20: 18329
OPTICAL SYSTEMS
design for large spark chamber viewing, 20: 19020 (CALT-68-30)
ORES
analysis using x-ray fluorescence, sources for, 20: 18593
ORGANIC ACIDS
carboxylic acid–TBP–H_2O, effect of hydrogen bonding on uranium distribution in, 20: 18845
ORGANIC COMPOUNDS
analysis for water using kryptonates, sensitivity of, 20: 18570(R) (NYO-2757-5)
analysis of methyl groups of, for carbon-14 and tritium, 20: 18600
diffusion in solid, tracer studies of self-, 20: 18673
radiation effects on crystalline, 20: 20360(R) (PRNC-73)
radiation effects on, 20: 20365
reactions with hydrogen, ESR studies of, 20: 18295(R) (UCLA-12-576, pp 27-56)
tritium-ion reactions at 40 kev, use of isotope separator for study of, 20: 18780
ORGANIC COMPOUNDS, METALLO-
molecular structure of iridium and platinum, 20: 18556(R) (BNL-929, pp 66-82)
ORGANIC COOLED REACTORS
heat transfer failure mechanisms in fuel bundles of, (E), 20: 20189
ORGANISMS
detection in extraterrestrial environments, 20: 18187(R) (N-65-16497)
ORGANS
polonium-210 content in, of smokers, 20: 18965
ORNITHINE
N-methyl-, preparation of carbon-14-labeled alpha- and delta-, 20: 18817
OROTIC ACID
radiation effects on uptake of carbon-14-labeled, by rat liver RNA, x, 20: 18263
OSMIUM ALLOYS
Os–Re, thermoelectric properties, 20: 20185 (CONF-650204-9)
Os–W, thermoelectric properties, 20: 20185 (CONF-650204-9)
OSMIUM ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)
OSMIUM ISOTOPES Os-182
nuclear data, 20: 19879
OSMIUM ISOTOPES Os-183
nuclear data, 20: 19880
OSMIUM ISOTOPES Os-184
nuclear data, 20: 19881
OSMIUM ISOTOPES Os-185
nuclear data, 20: 19882
OSMIUM ISOTOPES Os-186
energy level transitions from rhenium-186 decay, (E), 20: 19841 (UJV-1456/65)
OSMIUM ISOTOPES Os-188
energy levels of, high-spin rotational, (E/T), 20: 19953
OSMIUM OXIDES
effects on radiolytic oxidation in aqueous solutions, 20: 18790
OXALIC ACID
x-ray scattering by, Raman lines in, (E), 20: 18559 (CALT-221-14)
OXAZOLE, DIPHENYL-
2,5-diphenyloxazole–2,2′-*p*-phenylenebis[5-phenyl]oxazole, carbon-14 counting in solutions of, using balanced quenching method, 20: 18594
OXAZOLE, 2,2′-*p*-PHENYLENEBIS[5-PHENYL-
2,5-diphenyloxazole–2,2′-*p*-phenylenebis[5-phenyl]oxazole, carbon-14 counting in solutions of, using balanced quenching method, 20: 18594
OXIMES
8-hydroxyquinaldic, solvent properties for niobium and zirconium, 20: 18849
OXYGEN
content in tantalum, effect of, on low-temperature annealing after neutron irradiation, 20: 19268
corrosive effects on nickel, niobium, and tantalum, measurement of, by beta backscattering and x-ray induction, 20: 19196
diffusion in uranium dioxide, effects of crystal structure and temperature on, 20: 19234
effects on atomic hydrogen yields from low-pressure hydrogen discharge, 20: 18663
effects on concrete moisture-content measurements by thermal neutron scattering, 20: 18610
effects on irradiated barley seed, effects of seed water on, 20: 18389
effects on microstructure of cast niobium–zirconium alloys, 20: 19245
effects on product yields from radiolysis of liquid tetramethylsilane, scavenging, 20: 18729(R) (NYO-2007-9)
effects on quenching in liquid scintillation samples, reduction of, 20: 18712
effects on reactions of isopropylbenzene on gamma-irradiated alumina–silica, 20: 18768
effects on yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745
effects on yields from gamma radiolysis of tetrafluoromethane, 20: 18772
electron capture by, (E/T), 20: 18557 (ORNL-TM-1409)
electron pairing-correlation energies for, many-body perturbation theory for, 20: 19383
electron transitions of isotopic diatomic molecules of, Franck-Condon factors for, 20: 18658
energy levels in, mean lifetime of $2p^2\ {}^1D_2$, (E), 20: 19377
ionization equilibria in sun, (T), 20: 19338
meson (π^-) capture by, two-nucleon emission from, (E), 20: 19842 (UR-875-126, Paper 1)
production of molecular ions in atmosphere, crossed molecular-ion beam interactions for absolute cross section for, (E), 20: 19670
quenching effects on positronium in organic liquids, kinetics of, 20: 18662
radiation effects on chemisorption of, by calcia and magnesia, fast-neutron and gamma, 20: 18787
radiosensitivity effects on chromosomes in Ehrlich ascites tumor cells, x, 20: 18352
radiosensitivity effects in mice, x, 20: 18431
radiosensitivity effects on *Serratia marcescens*, x, 20: 18448
radiosensitivity effects on tumors, 20: 18464
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1915)

reactions with uranium(IV) iodide at 200, 300, and 400°C, 20: 18640
sorption by silver films, kinetics of, 20: 18808
spectra of Schumann-Runge bands of gaseous molecules of, isotope effects on intensities in, 20: 18659
spectral-line profile in theta-pinch hydrogen plasma, (E), 20: 20061

OXYGEN IONS
reactions with germanium-73 and nickel-61 at 25 Mev, Mössbauer spectra from, (E), 20: 19832 (ORNL-P-1966)

OXYGEN ISOTOPES O-13
production and delayed proton emission by, 20: 18557(R) (BNL-929, pp 66-827)

OXYGEN ISOTOPES O-15
energy levels of, (E), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of, odd-parity, (T), 20: 19984
use in medicine of cyclotron-produced, 20: 18515

OXYGEN ISOTOPES O-16
alpha emission, parities at 9 to 16 Mev for, (E), 20: 19273(R) (BNL-929, pp 3-43)
alpha reactions with, in water, production of fluorine-18 by, 20: 18809
bremsstrahlung reactions ($\gamma,\alpha n$) at 25 to 65 Mev, yield functions for, (E/T), 20: 19819 (IS-T-45)
deuteron reactions (d,α), angular distributions from, (T), 20: 19967
effects on Franck-Condon factors for electron transitions in oxygen molecules, 20: 18658
effects on intensities of Schumann-Runge bands of gaseous oxygen molecules, 20: 18659
electron elastic scattering by, dispersion corrections for, (T), 20: 19825 (LAL-1153)
electron inelastic scattering at 43, 59, and 69 Mev, transverse form factors of excited states from, (E), 20: 19897
energy levels from carbon-13 (He-3,γ) reactions, giant-dipole-resonance, (E), 20: 19908
energy levels of, odd-parity and rotational, (T), 20: 19984
gamma reactions (γ,p) at 14 to 16 Mev, cross sections for, (E/T), 20: 19852
neutron inelastic scattering at 14.1 Mev, gamma emission in, (E), 20: 19817 (INR-661/1A/PL)
proton reactions (p,α), angular distributions from, (T), 20: 19967
reactions (O-16,nγ) with tritium at 18 Mev, gamma spectra from, (E), 20: 19918

OXYGEN ISOTOPES O-17
energy levels of, odd-parity, (T), 20: 19984
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

OXYGEN ISOTOPES O-18
alpha reactions (α,n) at 2.8 Mev, level triplet from, (E), 20: 19909
content in marine atmosphere and sea water, variations in, 20: 18896 (NYO-3450-1, pp 277-374)
diffusion in quartz, proton bombardment method for study of, 20: 20127
effects on Franck-Condon factors for electron transitions in oxygen molecules, 20: 18658
effects on intensities of Schumann-Runge bands of gaseous oxygen molecules, 20: 18659
energy levels, (T), 20: 19984
exchange reactions on silver films, kinetics of, 20: 18808
incorporation in hydrogen peroxide, method for, 20: 18810
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

OXYGEN SYSTEMS
H–O, effects on yields in radiolysis of ferrous solutions containing sulfuric acid, 20: 18745

OZONE
production by fission-fragment-oxygen reactions, cost of, 20: 20177(R) (BNL-929, pp 83-105)
radioinduced formation from air, gamma, 20: 18746
radiosensitivity effects in mice, 20: 18454

P

PACIFIC OCEAN
age estimation of bones, shells, tools, and weapons on islands in, by carbon-14 method, 20: 18937
carbon-14 content of deep waters of, 20: 18934
niobium-95 content in marine organisms in northeast, 20: 18903 (RLO-1750-3)
radionuclides in sediments and surface waters, 20: 18902 (RLO-1725-41)
sulfur isotope content in volcanic materials from, 20: 18909
zinc-65 content in marine organisms in northeast, 20: 18903 (RLO-1750-3)
zirconium-95 content in marine organisms in northeast, 20: 18903 (RLO-1750-3)

PACKAGING
equipment for bulk, for long-term waste storage, 20: 20348 (RL-SA-60)

PAIR PRODUCTION
cross sections of, nuclear magnetic effects on, (T), 20: 19968

PALLADIUM ALLOYS
Fe–Pd, structure of, magnetic, 20: 20365
Mn–Pd, magnetic properties of Mn_2Pd_3, 20: 20360(R) (PRNC-73)

PALLADIUM HYDRIDES
neutron inelastic scattering by, determination of localized modes of hydrogen excess in, (E), 20: 20107 (EUR-2734.e)

PALLADIUM ISOTOPES Pd-106
energy levels of, g-factor and lifetime of, (E), 20: 19846

PALLADIUM ISOTOPES Pd-108
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

PANCREAS
content of enzymes in, 20: 18184(R) (BNL-929, pp 115-25)

PANTOTHENIC ACID
radiosensitivity effects in mice, 20: 18486

PAPAIN
radiation effects on papaya, gamma, 20: 18246(R) (UH-235P5-1, pp 7-13)

PARABIOSIS
effects on x-ray induced tumors in rats, 20: 18318

PARAMAGNETIC MATERIALS
Mössbauer effect in, line-shape theory for, (E/T), 20: 19273(R) (BNL-929, pp 3-43)

PARAMECIUM
radioinduced temperature-sensitive mutants, x, 20: 18348
radioinduced temperature-sensitive mutants in, effects of irradiation conditions on yield of x, 20: 18349

PARTICLE BEAMS
extraction from six-sector isochronous cyclotrons, 3/2 radial resonance in, 20: 19317

PARTICLE STATISTICS
Boltzmann equation with determinacy for, 20: 19584

PARTICLE TRACKS
analysis of bubble chamber, digital automatic pattern recognition system for, 20: 19046 (UCRL-16510)
analysis of, multidimensional correlation lattices for pattern reconstruction, 20: 19839 (UCRL-16478)
intensification in emulsions, methods for, 20: 19026 (INSJ-94)

PARTICLES
annihilation and production of, theory of first-passage distributions for, 20: 20101
counting of, electronic equipment for, 20: 18186(R) (LA-3432, pp 102-29)
deposition and dispersion of atmospheric, 20: 18988(R) (ORNL-929, pp 58-66)
motion in nonuniform temperature fields, (T), 20: 18868 (NYO-2930-5)
separation of, design of electronic equipment for, 20: 18186(R) (LA-3432, pp 102-29)
use of labeled, in medicine, 20: 18529

PEACH BOTTOM POWER REACTOR
coolant sorption isotherms for, use of radioactive tracers for measuring dynamic and static, 20: 18626 (GA-6865)
reactivity measurements in, 20: 20238(R) (GA-6829)

PEAS
radiation effects on, mutagenic, 20: 18409

PEBBLE BED REACTORS
design of 1000-Mw(e) settled-bed, 20: 20230 (BNL-887)

PECTINS
radiation effects on papaya, gamma, 20: 18246(R) (UH-235P5-1, pp 7-13)

PENNSYLVANIA
radium control in, medical, 20: 18981

PENTANE, 3-METHYL-
photoionization and radiation effects on positive-hole migration in, containing *N,N,N′,N′*-tetramethylphenylenediamine, 20: 18753
radiation effects on positive-hole migration in additive-containing, gamma, 20: 18753

2,4-PENTANEDIONE, TRIFLUORO-
solvent properties for niobium and zirconium, 20: 18833

PENTANES
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742

1-PENTANOL
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)

2-PENTANONE, 4-METHYL-
solvent properties for hafnium and zirconium thiocyanates, 20: 18828

PENTOBARBITAL SODIUM
radiosensitivity effects in mice, 20: 18459

PEPTIDES
effects of neurohypophyseal, physiological, 20: 18185(R) (BNL-929, pp 126-47)

PERCHLORATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

PERCHLORIC ACID
dissociation in 2 to 12*M* aqueous solutions, 20: 18556(R) (BNL-929, pp 66-82)
PERIODATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
PERMANGANATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
spectra of, infrared, 20: 18700
PERMEABILITY
methods for characterizing fine powders, 20: 19181 (SC-DC-66-1297)
PERRHENATES
spectra of, infrared, 20: 18700
PERSONNEL
fallout effects on Marshallese, annual survey for 1965, 20: 18185(R) (BNL-929, pp 126-47)
monitoring at Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)
radiation hazards to radon laboratory, 20: 18956
training at Puerto Rico Nuclear Center, 20: 20360(R) (PRNC-73)
PERTECHNETATES
spectra of, infrared, 20: 18700
PETROLEUM
production of, uses of radioisotopes in industrial, 20: 19128
radiation heating in underground reservoirs, 20: 19131(P)
radioinduced thermal cracking of gas-oil fractions, 20: 18785(T)
PHANTOMS
radiation dosimetry in thin, γ and x, 20: 18977
PHARMACOLOGY
book: *Progress in Biochemical Pharmacology*, 20: 18238
nuclear energy in, review, 20: 20367
PHARYNX
radiotherapy of naso-, carcinogenesis after childhood x, 20: 18412
PHENANTHRENE
effects on radiolytic isomerization of stilbene in benzene solutions, 20: 18735
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
PHENETHYLAMINE, α-METHYL-
effects on mice, effects of x radiation on toxic, 20: 18380
PHENOL
critical solution temperature in light and heavy water, deuterium effects on, 20: 18720
PHENOL, NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)
PHENOLS
association with sulfoxides, 20: 20360(R) (PRNC-73)
production in decomposition of anisole by heat, 20: 19135(R) (K-C-718)
PHENOTHIAZINE, 3-CHLORO-10-(3'-DIMETHYLAMINOPROPYL)-
effects on food intake by x-irradiated rats, 20: 18367
PHENOTHIAZINE, 2-CHLORO-10-[3-(4-METHYL-1-PIPERAZINYL) PROPYL]-
radiosensitivity effects in mice, 20: 18491
p-PHENYLENEDIAMINE, N,N,N',N'-TETRAMETHYL-
photoionization and radiation effects on positive-hole migration in 3-methylpentane containing, 20: 18753
PHOSPHATE GLASS
radiation effects on ESR spectra of, gamma, 20: 19256(R) (NYO-2024-9)
PHOSPHATES
effects on polarographic reduction of benzophenone in ethanol–water system, 20: 18636(R) (TID-22725)
radiation effects on release by yeast, 20: 18503 (AD-611869, pp 169-83)
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
radiosensitivity effects on barley seeds, effects of pH on x, 20: 18435
PHOSPHATIDES
synthesis in mammalian cells in culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
PHOSPHINE OXIDE, METHYLENEBIS[DIHEXYL-
analytical use for reversed-phase chromatographic separation of rare earths, thorium, and uranium, 20: 18599
PHOSPHINE OXIDE, TRIBUTYL-
complexes with uranyl halides, preparation of, 20: 18646
PHOSPHINE OXIDE, TRIOCTYL-
dodecylamine–HNO_3 trioctylphosphine oxide, distributions coefficients for americium, curium, plutonium, and promethium ions in, 20: 18561 (EUR-2635.d)
PHOSPHINE OXIDES
solvent properties for rare earths, 20: 18850
PHOSPHITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
radiolytic oxidation of aqueous solutions of, effects of osmium tetroxide on, 20: 18790
PHOSPHONIC ACIDS
solvent properties for rare earths, 20: 18850
PHOSPHOPROTEINS
synthesis in mammalian cells in culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
PHOSPHORIC ACID
organic derivatives, radiosensitivity effects in mice and tissue cultures, 20: 18482
PHOSPHORIC ACID, BIS(2-ETHYLHEXYL) ESTER
solvent properties for rare earths, 20: 18837
PHOSPHORIC ACID, ESTERS
solvent properties for rare earths, 20: 18850
PHOSPHORS
carbon-14 counting in solution of, using balanced quenching method, 20: 18594
efficiency of plastic, for x-ray flux at 1.8 to 4.5, 20: 19066
scintillation quenching of, reduction of oxygen, 20: 18712
scintillation response of, computer program for calculating, 20: 19022 (CALT-68-62)
PHOSPHORUS
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
determination in mixture with sulfur, activation, 20: 18569 (NP-15887)
PHOSPHORUS IONS
reactions with silicon at 10 to 80 kev, production of electric junctions by, 20: 20123
PHOSPHORUS ISOTOPES P-31
energy levels of, parity and spin of, (T), 20: 19816 (INP-441/PL)
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
PHOSPHORUS ISOTOPES P-32
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
beta dosimetry for, in therapy, 20: 18544
effects of incorporated, on resistance transfer factor episome in *E. coli*, 20: 18254
effects on cardiac function, 20: 18328
effects on polycythemia, 20: 18525
effects on polycythemia, 20: 18527
effects on rat leukocytes, protective effects of B vitamins against, 20: 18499
production in human hair, use in determining neutron doses, 20: 18198
radiation effects on uptake by rat kidney and liver, effects of cyclohexanol and synkavite on x, 20: 18379
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
sorption in dog intestine, effects of high-frequency and ultrasonic vibrations on, 20: 18219
uptake by bones, effects of radioprotective compounds on, 20: 18479
uptake of chromium phosphate-incorporated, by lymph nodes of rabbits, 20: 18241
use for therapy of polycythemia, 20: 18554
PHOSPHORUS SYSTEMS
P–S, analysis for phosphorus and sulfur, activation, 20: 18569 (NP-15887)
PHOTOCHEMISTRY
effect on biological materials at cellular level, 20: 18390
effects on uv-induced inactivation of Euglena chloroplasts, 20: 18253
energy transfer in flash photolysis, 20: 20365
PHOTOELECTRIC CELLS
cesium measurement in antimony–cesium layers in, by gamma spectrometry, 20: 18617
radiation effects on cadmium sulfide, gamma, 20: 19098(R) (N-65-17953)
PHOTOELECTRIC EFFECT
theory of anomalous and normal, in crystals, 20: 20147
PHOTOGRAPHIC EMULSIONS
resolution limits of, for high frequencies, Young fringes for determining, 20: 18997
use in synchrotron beam profile measurements, 20: 19289 (CALT-68-20)
PHOTOGRAPHIC FILM
scanning for oscillographic traces, semi-automatic system for, 20: 18991 (LNF-65/43)
PHOTOMULTIPLIER TUBES
calibration procedure for antiproton-proton experiments, 20: 19019 (CALT-68-27)
design using semiconductor diodes, 20: 19042 (UCRL-14445)
gain changes of 56 AVP, 20: 19007
performance of, dark pulses and gain shift effects on, 20: 19037(R) (NYO-3431-6)
performance of, error statistics for, 20: 19053

PHOTONS
absorption by atoms, review of theories for resonances in, 20: 19361
amplification of coherent gamma, using nuclear pumping, 20: 20201(R) (ANL-7110, pp 311-401)
angular correlation of positron-annihilation, in sodium, (E), 20: 20167
detection of high-energy, instrument development for, 20: 19032(R) (N-65-23928)
field states in quantum electrodynamics, nth-order coherence in, 20: 19718
interactions with nucleons, meson (π) production in, (T), 20: 19447 (UCRL-14614-T)
interactions with electrons, theory of first-passage distributions for cascade, 20: 20101
interactions with nucleons, multipoles in meson (π^0) production from, (E/T), 20: 19493
interactions with nucleons, T-invariance violation in, (T), 20: 19513
interactions with deuterons and nucleons, isotopic relations for mesons (K) and (π) production amplitudes from, (T), 20: 19518
interactions with baryons, coupling constants for, (T), 20: 19539 (JINR-E-2544)
interactions with elementary particles, mechanism of CP violation in, (T), 20: 19578
interactions with electrons at high energies, double logarithmic asymptotics of Compton, 20: 19580
momentum distribution of, from positron annihilation in lithium and sodium, (E), 20: 20169
monitoring of beams of, time-domain analysis for, 20: 19514
reactions with calcium-48 and carbon-14, cross sections for absorption and disintegration, (T), 20: 19969
reactions with helium-3 and -4, cross sections for disintegration, (T), 20: 19964
reactions with nuclear Coulomb field, nuclear magnetic effects on pair production in, (T), 20: 19968
reactions with nuclei, total absorption cross sections for, (T), 20: 19991
PHOTOSENSITIVITY
effects of furocoumarins on animal cell and viruses, 20: 18469
effects of furocoumarins on skin, of guinea pigs and man, 20: 18466
effects of morphology on plant virus, 20: 18360
PHOTOSYNTHESIS
biochemical aspects of algal, tracer study, 20: 18206(R) (N-65-16815)
radiation effects on, infrared and uv, 20: 18365
PHYSICS
research on solid state, 20: 20114(R) (ORNL-3935)
research programs on theory of high-energy, (E/T), 20: 20365
research programs on low-energy, 20: 20365
symmetries in, status of, 20: 19612
time-reversal invariance in, testing of, (T), 20: 19601
PIGMENTS
radiation effects on plant content of, uv, 20: 18365
radiation effects on mouse hair, effects of melanogenetic substrates on x, 20: 18502
use of uranium compounds as, for ceramic glazes, 20: 18974
PINCH DEVICES
plasma losses in toroidal theta, with superimposed hexapole, (E), 20: 19999 (IPP-1/44)
PINCH EFFECT
plasma production by, in linear discharge, (E/T), 20: 20029
PINELLAS PENINSULA PLANT, FLA.
environs monitoring, 1964, 20: 18915
PIPE JOINTS
fabrication of plastic, by radioinduced crosslinking, 20: 19129(P)
PIPES
fluid flow in, temperature interactions from turbulent, (T), 20: 18873 (UCB-34P64-1)
PITUITARY GLAND
radiotherapy of, β, 20: 18532
PLACENTA
localization by arteriography, 20: 18520
PLANARIA
macromolecular changes in, during learning, 20: 18556(R) (BNL-929, pp 66-82)
PLANETS
origin of, chemical evidence relative to, 20: 19346
PLANKTON
ecology of off-shore Puerto Rican, 20: 20360(R) (PRNC-73)
effects on marine food web, 20: 18198
radioactivity from gamma emitters in, in Gulf of Mexico, 20: 18200 (NYO-3450, pp 109-29)
PLANT CELLS
radiation effects on morphology of, in tobacco seedlings and tissue cultures, 20: 18383
resistance to heat and hydrostatic pressure, effects of heavy water on, 20: 18218(T)
PLANT METABOLISM
radiation effects on lipid, in cotton seedlings, γ, 20: 18374
PLANT RESPIRATION
effects of radiomimetic substances and thiols on, in bacteria, 20: 18481
PLANTS
analysis for manganese, activation, 20: 18602
cesium uptake from soils by, effects of soil chemistry on, 20: 18208(R) (TID-22715)
contamination of forage, after nuclear accident, 20: 18969
effects of rare earths on Phaseolus, 20: 18237
fission product uptake by grain and oil-bearing, 20: 18906(T)
forage yield from, beta attenuation method, 20: 19119
growth and photoperiodism in, 20: 18184(R) (BNL-929, pp 115-25)
growth of, effects of radioactive dusts on, 20: 18211(R) (UCLA-12-576, pp 89-111)
growth of, effects of dissolved carbon dioxide or beryllium on, 20: 18211(R) (UCLA-12-576, pp 88-111)
growth regulators in, effects on ascites tumors, 20: 18426
iodine-131 deposition on forage, effects of meteorological conditions on, 20: 18941(R) (IDO-12047)
morphogenesis in, 20: 18184(R) (BNL-929, pp 115-25)
morphology of viruses infecting, 20: 18360
radiation effects on photosynthesis in, uv, 20: 18365
radiation effects on growth and morphology of, at thermonuclear test site, 20: 18386
radiation effects combined with magnetic fields on germination and seedling development in, x, 20: 18388
radiation effects on, gamma, 20: 18390
radiation effects on leaves of, photoreactivation of solar and uv, 20: 18391
radiation effects on leaves of Xanthium, combined solar and uv, 20: 18391
radiation effects on, γ, 20: 18400
radiation effects on sunflower, mutagenic, 20: 18409
radiation effects on vegetables, mutagenic, 20: 18409
radiation effects on rice, genetic x, 20: 18416
radiation effects on meal of Pisum, protective effects of water against, 20: 18429
radiation effects on ecology of, at Nevada Test Site, 20: 18211(R) (UCLA-12-576, pp 89-111)
radiation effects on genetic processes of, 20: 18198
radiation effects on biochemistry of, review of large-dose, 20: 18277
radiation effects on *Medicago polymorpha*, x, 20: 18312
radiation effects on lupine and turnip, following seed soaking in phosphorus-32 solutions, 20: 18442
radiation effects, genetic γ and neutron, 20: 18188(R) (ORO-635)
radiation exposure of, facilities for γ, 20: 18400
radioinduced mutations in jute *Corchorus olitorius*, 20: 18385
radioinduced mutations of, use in field crop breeding programs, 20: 18420
radionuclide content in marine, in northeast Pacific Ocean, 20: 18903 (RLO-1750-3)
radiosensitivity effects of genetic constitution, developmental stage, temperature, and dose rate on, 20: 18420
strontium uptake, effects of soil liming on, 20: 18303
strontium-90 uptake by pasture, 20: 18232
use as radiation dosimeter during space flight, 20: 18964
PLASMA
acceleration by electromagnetic fields, 20: 20003 (N-65-16442)
antenna emission patterns in compressible, reciprocity relations for, (T), 20: 20037
charged-particle beam motion in, oscillation excitation in, (T), 20: 20063
Cherenkov radiation in warm, in infinite magnetostatic field, (T), 20: 20051
containment by coaxial jet-MHD-driven vortex, for nuclear rockets, (T), 20: 20299 (NP-15903)
containment by MHD-driven vortex, for nuclear rockets, (E), 20: 20300 (NP-15904)
containment of, compensation of distortions in helical magnetic fields for, (E/T), 20: 20080
current density and electromagnetic waves in inhomogeneous, nonlinear second harmonic of, (T), 20: 20038
current harmonic production in weakly ionized argon, in electric field, (T), 20: 20031
density variations in turbulent weakly ionized argon, (E/T), 20: 20049
diagnostics of anisotropic, turnstile multiple probe polarimeter for, 20: 19996 (AFCRL-66-17)
diagnostics of arc, using spectroscopy, (E), 20: 20010(R) (N-65-23211)
diagnostics of, frequency shifts in X-band cavities for, 20: 20055
diagnostics of, spherical probe for, (T), 20: 20073
diagnostics using Langmuir probes, (E), 20: 20007 (N-65-22196)
diagnostics using ion beams, 20: 20009 (N-65-22617)
diagnostics using microwaves, method of, 20: 20012 (N-65-27813)

diffusion across magnetic fields, effects of microinstabilities on, (E), 20: 20017(R) (NYO-2813-36)
diffusion expansion of laser-produced, in uniform magnetic field, (E), 20: 20045
diffusion in high-voltage PIG reflex discharge, anomalous, (E), 20: 20083
diffusion of quiescent potassium magneto-, cross-field, (E), 20: 20016 (NYO-2813-35)
drift of radially compressed, (T), 20: 20023
electric conductivity in electromagnetic fields, 20: 20003 (N-65-16442)
electric conductivity of non-neutral inhomogeneous partially ionized, Ohm's law for, (T), 20: 20027
electric conductivity of gas discharge, r-f method for measuring, 20: 20088
electric conductivity of slightly ionized nonequilibrium, (T), 20: 19417(R) (N-65-21774)
electric double layer in mercury-vapor discharge, thickness of cylindrical, (E), 20: 20086
electric impedance of diode filled with rarefied, frequency dependence of, (T), 20: 20090
electric probes in collisionless, edge phenomena in unified theory for, 20: 20041
electromagnetic surface wave propagation in, perpendicular to magnetic field, (T), 20: 20075
electromagnetic wave interactions with longitudinal waves in, nonlinear, 20: 20021
electromagnetic wave interactions in gaseous, nonlinear, (E/T), 20: 20032
electromagnetic wave emission from nonlinear interactions of surface oscillations in, (T), 20: 20035
electron and ion densities in glow discharge hydrogen, between coaxial dielectric cylinders, (T), 20: 20068
electron beam interactions with, h-f oscillations from, (E), 20: 20079
electron concentration in helium, measurement using open cylindrical resonators, 20: 20072
electron cyclotron harmonics in, dispersion properties of, (E/T), 20: 20000 (IPP-2/43)
electron densities in theta-pinch, discharge-coil effects on space- and time-resolved, (E), 20: 20060
electron density in shock-produced argon, microwave-reflection measurement of high, (E), 20: 20022
electron density in laser-beam produced, microwave and probe measurements of, (E), 20: 20045
electron density in decaying-afterglow, time-resolved microwave interferometry for, 20: 20054
electron interactions in, quasisingle particle approximation for, 20: 20036
electron temperatures in hot argon–potassium discharge, (E), 20: 20024
electron temperature in theta-pinch deuterium, effect of impurities on, (E), 20: 20046
electron-beam motion in helium, electromagnetic radiation from, (E), 20: 20071
electron-ion recombination in helium, in spherical container, (E), 20: 20070
electrons in, nonlinear 13-moment approximation for run-away, 20: 20059
Faraday effect in anisotropic, (T), 20: 20020
flow in crossed fields, electron-temperature variations in, (T), 20: 20076
Fokker-Plank equation for, general 13-moment approximation for, 20: 20057
hydromagnetic waves in uniform cold, properties of three-dimensional, (T), 20: 19693
interactions of polarized countercurrent streams of, in biconical cusped magnetic field, (E), 20: 20081
ion and light emission from, time dependence of, (E), 20: 19995(R) (AD-630123)
ion cyclotron instabilities in E.O.S. device, electrostatic character and wave structure of, (E), 20: 20028
ion cyclotron waves in, r-f power transfer to, (T), 20: 20013 (NASA-TN-D-3361)
ion distribution in vacuum spark, 20: 20025
ion energy loss in arc discharge, in magnetic fields, (T), 20: 20074
ion-beam interactions with, in magnetic field, (T), 20: 20066
kinetic equation for, using Darwin hamiltonian, (T), 20: 20091
kinetics of electron-positron, relativistic, (T), 20: 20050
kinetics of, collision and nonlinear effects in, (T), 20: 20011 (N-65-25265)
laser beam scattering by dense theta-pinch, electron density and temperature from, (E), 20: 20043
light absorption by, monochromatic nonlinear, (E/T), 20: 19628
microwave amplification in cesium and mercury, 20: 20052
microwave emission from PIG reflex discharge, (E), 20: 20082
microwave scattering by, magneto-Kerr effect in, (E/T), 20: 20014 (NP-15938)
microwave scattering by turbulent helium, in magnetic fields, (E), 20: 20039
moment equation of, Onsager relations from transport coefficient from linearized 13-, 20: 20058
motion in axially symmetric magnetic field, density and temperature variations with, (E), 20: 20084
oscillations in magnetic fields, initial-value problem for, (T), 20: 20004 (N-65-16489)
oscillations in magnetized column of argon, harmonic generation from helical, (E), 20: 20040
oscillations in opposing streams of nonuniform, excitation of, (T), 20: 20062
oscillations of electron, in magnetosphere, (E/T), 20: 19644 (N-65-23933)
particle-wave interactions in homogeneous nonisotropic, kinetic equation for, 20: 20026
potential measurements in quiescent, electron emissive probes for, (E), 20: 20053
production and propagation of supersonic streams of, in discharge shock tubes, (E), 20: 20089
production by interactions of electron beam in gases, (E), 20: 20078
production by laser-beam cathode heating, electron current pulse from, 20: 19283
production in thermionic cells, methods of, 20: 19415 (N-65-16645)
production of dense quasispherical, by self-pinch in linear discharge, (E/T), 20: 20029
properties of h-f discharge, magnetic-field effects on, (E), 20: 20087
properties of two-fluid anisotropic warm, principal coordinates for formulating, 20: 20048
radiation losses of finite volume of unbounded, (T), 20: 20034
research, 20: 20015(R) (NP-15940)
sound propagation in afterglow, Tonks-Dattner resonance determination of, (E), 20: 20044
spectral line shifts in, design of interferometer for measurement of, 20: 20042
spectral-line profiles of nitrogen and oxygen impurity ions in theta-pinch hydrogen, (E), 20: 20061
stability in electric field, effect of electron heating on acoustic, (T), 20: 20067
stability in Q devices, (T), 20: 20018(R) (TID-22785)
stability of arc, in axial magnetic field, (E/T), 20: 20008 (N-65-22329)
stability of bumpy linear, $\beta = 1$, theta pinch, (T), 20: 20002 (LA-3442)
stability of cylindrical beams of, electrostatic, (T), 20: 20030
stability of rotating filament of, in presence of h-f radial pulsations, (T), 20: 20077
stability of spatially nonuniform current-carrying, in magnetic field, (T), 20: 20064
stability of spatially nonuniform current-carrying, in magnetic field, (T), 20: 20065
stability of toroidal theta pinch, with superimposed hexapole, (E), 20: 19999 (IPP-1/44)
striation production in hollow-cathode, (E), 20: 20085
thermodynamic equilibrium of hydrogen, deviations from, (T), 20: 20033
thermodynamic properties of, bibliography on, 20: 18630 (NP-15896)
transitions in hydrogen, forbidden continuum in free-bound, (T), 20: 20047
wave excitation and propagation in collisionless, (E), 20: 20005(R) (N-65-19889)
wave excitation and propagation in collisionless, (E), 20: 20006(R) (N-65-19896)
wave interactions in, ion acoustic and h-f oscillation, (E), 20: 20069
wave propagation in, solution for functions of helicon, (T), 20: 19997 (CLM-R-48)

PLASMA JETS

containment of coaxial, for nuclear rockets, (T), 20: 20299 (NP-15903)
containment of, for nuclear rockets, 20: 20300 (NP-15904)
feasibility of a-c MHD, as space vehicle thruster, 20: 18888
heating in cascade-arc, 20: 18882 (N-65-16890)
properties of periodic, nonlinear theory for, 20: 20056
review of, for space propulsion, (E/T), 20: 18887 (NASA-TN-D-3332)
velocity of, measurement using volatile impurities, 20: 20001 (IPP-3/36)
velocity profiles in, confined by transverse magnetic field, (E), 20: 19626

PLASTICS

corrosion of Viton by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
efficiency of scintillators of, for x-ray flux at 1.8 to 4.5 kev, 20: 19066

PLATES

magnetohydrodynamic gas flow boundary layer on thermally insulated, semi-infinite flat, compressibility effects on, (T), 20: 19632
photothermoelasticity of, with central hole and other peripheral holes, 20: 19237
stress analysis of, drive system for determining, 20: 18879 (AWRE-O-21/66)

PLATINATES

molecular structure, 20: 18556(R) (BNL-929, pp 66-82)
PLATINUM
coating anode of, with radioisotopes, effects of hydrogen ion concentration on, 20: 18676
krypton-ion reactions at 9 kev, diffusion theory for depth distributions from, 20: 20126
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
radiolytic oxidation of aqueous solutions of, effects of osmium tetroxide on, 20: 18790
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
PLATINUM ALLOYS
Pt–Re, analysis for rhenium by bremsstrahlung activation methods, 20: 18614
Pt–Rh, analysis for rhodium by bremsstrahlung activation methods, 20: 18614
PLATINUM ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)
PLATINUM ISOTOPES Pt-182
nuclear data, 20: 19879
PLATINUM ISOTOPES Pt-183
nuclear data, 20: 19880
PLATINUM ISOTOPES Pt-184
nuclear data, 20: 19881
PLATINUM ISOTOPES Pt-185
nuclear data, 20: 19882
PLATINUM ISOTOPES Pt-188
beta decay of, iridium-188 55-kev level half life from, (E/T), 20: 19955
PLATINUM ISOTOPES Pt-192
electron energy levels, (E), 20: 19915
energy levels of, 2^+ and 4^+, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
PLATINUM ISOTOPES Pt-195
energy levels of, core-excitation model for excited, 20: 19923
PLUTONIUM
analysis for thorium, spectrophotometric, 20: 18566 (LA-3469)
bibliography on, 20: 20355 (BNWL-113-12)
bibliography on, 20: 20356 (BNWL-113-13)
corrosive effects on carburized and noncarburized tantalum, 20: 20239(R) (LA-3482)
density measurements of, liquid media for, 20: 19219 (RFP-691)
determination in plutonium and uranium dioxides and plutonium–uranium monocarbide fuels, methods for, 20: 18578 (TRG-Report-1165)
determination in solutions by alpha spectrometry and isotope dilution, 20: 18568(R) (NBL-230)
determination in solutions, automatic titrator for, 20: 18568(R) (NBL-230)
determination of, evaluation of methods for, 20: 18568(R) (NBL-230)
diffusion in alpha-uranium grain boundaries during grain growth, 20: 19235
effects of inhaled, on animals and man, 20: 18198
materials management during fabrication, handling, measurement, and shipping at Rocky Flats, Colo., 20: 18948 (RFP-720)
monitor for, in aerosols, 20: 19057
performance as thermal reactor fuel, 20: 20231 (BNWL-SA-547)
preparation of thick and thin sources of, by electroplating and electrophoresis, 20: 18562(R) (EUR-2640.e)
radiation damage in, self, 20: 20365
sample preparation procedures for, metallographic, 20: 19176 (ANL-6975)
separation from fission products and uranium in reactor fuels by fluid-bed fluoride volatility process, 20: 18821 (ANL-7077)
thermodynamic properties of gaseous, at 298 to 20,000°K, 20: 18637(T) (KFK-tr-177)
PLUTONIUM ALLOYS
analysis for tantalum, spectrophotometric, 20: 18565 (LA-3465)
analysis for thorium, spectrophotometric, 20: 18566 (LA-3469)
sample preparation procedures for, metallographic, 20: 19176 (ANL-6975)
Ce–Co–Pu, corrosive effects on tantalum and tantalum–tungsten alloys, 20: 20239(R) (LA-3482)
Ce–Co–Pu, radiation effects on liquid, 20: 20183
Fe–Pu, corrosive effects on tantalum, 20: 20239(R) (LA-3482)
fission–Pu–U, compatibility with cladding materials, 20: 20183
PLUTONIUM CARBIDES
PuC–UC, compatibility with cladding materials, 20: 19183
PuC–UC, radioinduced swelling in mixed, 20: 19183
PuC–UC, uses as fuel for fast reactors, 20: 19183
PLUTONIUM COMPOUNDS
analysis for thorium, spectrophotometric, 20: 18566 (LA-3469)
PLUTONIUM FLUORIDES
conversion to oxides in fused salts, 20: 18824(R) (EURAEC-1536)
PLUTONIUM IONS
solvent distribution in nitric acid solutions with dodecylamine and trioctylphosphine oxide in diethylbenzene, effects of lithium nitrate on, 20: 18561 (EUR-2635.d)
thermodynamic properties of gaseous, at 298 to 20,000°K, 20: 18637(T) (KFK-tr-177)
PLUTONIUM ISOTOPES
separation and processing using ORNL calutrons, 20: 19165
PLUTONIUM ISOTOPES Pu-237
use in metabolic studies, assessment of, 20: 18221
PLUTONIUM ISOTOPES Pu-238
energy levels of, high-spin rotational, (E/T), 20: 19953
production by fuel recycle, economics of, 20: 19133 (DUN-SA-4)
production from irradiation of neptunium-237, 20: 19134 (DUN-SA-5)
PLUTONIUM ISOTOPES Pu-239
calibration of, methods for, 20: 18562(R) (EUR-2640.e)
dosimetry of, equation for internal, 20: 18955
effects on animals and man, 20: 18198
measurement in lungs using proportional counters, 20: 18186(R) (LA-3432, pp 102-29)
neutron capture-to-fission ratio, 20: 20200(R) (ANL-7110, pp 29-98)
neutron reactions to 200 ev, resonance parameters in, (E), 20: 19856
neutron scattering amplitudes of, coherent, (T), 20: 19845
uptake by lobster tissues, 20: 18227
PLUTONIUM ISOTOPES Pu-240
dosimetry of, equation for internal, 20: 18955
energy levels of, high-spin rotational, (E/T), 20: 19953
PLUTONIUM ISOTOPES Pu-241
neutron capture-to-fission ratio, 20: 20200(R) (ANL-7110, pp 29-98)
PLUTONIUM(IV) OXIDES
analysis for plutonium and uranium, methods for, 20: 18578 (TRG-Report-1165)
fluorination of, fluidized-bed method for, 20: 18821 (ANL-7077)
neutron Doppler measurements in ZEBRA core 5, 20: 20310 (AEEW-R-465)
production by precipitation from fused salts, 20: 18824(R) (EURAEC-1536)
reactions with Nichrome at 1093°C, 20: 19178(R) (IDO-17154)
BeO–PuO_2–ThO_2, fabrication of dispersions of, process development for, 20: 19177(R) (BMI-1757)
PuO_2–UO_2, conversion to fluorides by reaction with chlorine trifluoride and hydrogen fluoride, 20: 18824(R) (EURAEC-1536)
PuO_2–UO_2, neutron buckling in graphite lattices fueled by, (T), 20: 20199 (AEEW-R-466)
PuO_2–UO_2, neutron buckling in graphite lattices fueled by, (E), 20: 20198 (AEEW-R-464)
PuO_2–UO_2, neutron Doppler measurements in ZEBRA core 5, 20: 20310 (AEEW-R-465)
PuO_2–UO_2, radiation effects on microstructure of, in-pile, 20: 19257 (TID-22716)
PLUTONIUM SULFATES
preparation for isotopic standards, 20: 18568(R) (NBL-230)
PLUTONIUM SYSTEMS
Pu–UC, analysis for plutonium and uranium, methods for, 20: 18578 (TRG-Report-1165)
PNEUMOCOCCI
genetic transformations in, 20: 18184(R) (BNL-929, pp 115-25)
PODOPHYLLIN
radiosensitivity effects on tumors, 20: 18537
POLAND
rare earth contents in eclogites from Nowa Wies in Snieznik Klodzki, 20: 18900
POLARISCOPES
design of turnstile multiple probe, for plasma diagnostics, 20: 19996 (AFCRL-66-17)
POLLEN
radioinduced mutations in mother cells of maize, γ, 20: 18335
radioinduced mutations in maize, frequency of γ, light, and uv, 20: 18392
radioinduced mutations in tomato, factors affecting frequency of γ, 20: 18393
radiosensitivity of, effects of plant nuclei size on γ, 20: 18384
use as radiation dosimeter during space flight, 20: 18964
POLONIUM ISOTOPES Po-210
content in cigarettes, 20: 18965
content in organs of smokers, 20: 18965
dosimetry of, equation for internal, 20: 18955
POLONIUM ISOTOPES Po-212
alpha decay of, recoil-atom charge from, (E), 20: 19867
POLYCYTHEMIA
chemotherapy of, compared with phosphorus-32 therapy, 20: 18525
radiotherapy of, β, 20: 18527
radiotherapy of, compared with chlorambucil therapy, 20: 18525
radiotherapy of, dosimetry in phosphorus-32, 20: 18544

radiotherapy using phosphorus-32, 20: 18554
POLYMERIZATION
radioinduced, of inclusion compounds, kinetics of, 20: 18784(T)
POLYMERS
structure of crystalline, 20: 20365
POLYPHENYLS
composition of pyrolyzed and radiolyzed, methods for determining, 20: 18560 (EUR-2454.f)
purification by ion exchange using Attapulgus clay, 20: 18625 (EUR-2646.e)
separation of tetraphenyls from, by fractional crystallization in solvents, 20: 18560 (EUR-2454.f)
POPULATIONS
genetic load of, analysis of, 20: 18190(R) (UCRL-16613)
genetic structure of Drosophila, 20: 18333
radiation dose to U. S., 1963 to 1965 fallout, 20: 18980
radiation hazards to, from contaminated food and water, 20: 18976
PORPHYRINS
content in duck erythrocytes, 20: 18184(R) (BNL-929, pp 115-25)
PORTLAND CEMENTS
moisture content in concretes of, atomic effects on thermal neutron scattering determination of, 20: 18610
POSITRONIUM
effects of nitric oxide and oxygen on quenching of, in organic liquids, 20: 18662
production in gases, liquids, and solids, review of, 20: 19460
POSITRONS
annihilation in beryllium, (E), 20: 20167
annihilation in lithium and sodium single crystals, Fermi surface determination from, (E), 20: 20169
annihilation in metals, origin of second lifetime component from, (E), 20: 19486
annihilation in metals, (T), 20: 19499
annihilation in sodium, temperature effects in, (E/T), 20: 20167
detection of, scintillation camera for, 20: 19085
interactions with antineutrinos and neutrinos, cross sections for, (T), 20: 19463
performance in scanning of head, 20: 18185(R) (BNL-929, pp 126-47)
reactions in gases, liquids, and solids, review of, 20: 19460
scattering by helium, cross sections and phase shifts for low-energy, (T), 20: 19381
POTASSIUM
boiling heat transfer by liquid, 20: 18870(R) (SAN-409-28)
content in diabetic patients, determination by whole-body counting of potassium-40, 20: 18509(R) (UCLA-12-576, pp 61-80)
content in diet in U. S., 1961 through 1964, 20: 18920
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
content in Phaseolus, effects of rare earths on, 20: 18237
content in rocks in United States, age estimations from, 20: 18924(R) (NYO-1669-11)
diffusion of quiescent magnetoplasma of, cross-field, (E), 20: 20016 (NYO-2813-35)
effects on determination of moisture content of soils by neutron method, 20: 19118
electron beam interactions with polarized atomic beams of, spin-exchange, (E), 20: 19375
heat transfer from boiling, 20: 20177(R) (BNL-929, pp 83-105)
heat transfer from boiling, 20: 20183
ion exchange properties on zirconyl oxalates, 20: 18840
radiation effects on content in muscle, γ and x, 20: 18293 (NP-14898)
surface tension at melting to boiling point, use of maximum bubble pressure method for measuring, 20: 18624 (CU-2660-24)
POTASSIUM BROMIDES
exchange reactions with bromine vapor, 20: 18695
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
POTASSIUM CARBONATES
sorption by glass surfaces, 20: 18846
POTASSIUM CHLORATES
radiation effects on defects in monocrystalline, uv and x, 20: 20117
POTASSIUM CHLORIDES
color centers in, specular reflection variations from, (E), 20: 20105(R) (COO-587-19)
preparation of single-crystals, 20: 20365
radiation effects on density changes and F-center concentration in, x-, 20: 20163
radioinduced F centers in, computer-simulated kinetics of Varley mechanism for, 20: 20142
KCl–NaCl, reactions of ammonia with uranium tetrachloride in molten, precipitation of uranium nitrides by, 20: 18698
POTASSIUM CHROMATES
chromium-51 reactions at 5 to 450 kev, chemical distribution following, 20: 18781
radiation effects on chromium in crystalline, 20: 18556(R) (BNL-929, pp 66-82)
uses in titrimetric determination of lanthanum, effects of ethanol on, 20: 18606
POTASSIUM FERROCYANIDES
radiolysis of aqueous solutions of, pulse, 20: 18769
POTASSIUM FLUORIDES
B_2O_3–KF, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
POTASSIUM IODATES
gamma reactions (γ,n) in, retention of iodine-126 in, 20: 18726 (IS-T-74)
iodine-127 and -129 Mössbauer isomer shifts in, (E), 20: 20139
POTASSIUM IODIDES
color centers in, properties of V_K, (E), 20: 20115 (ORNL-TM-1422)
iodine-127 and -129 Mössbauer isomer shifts in, (E), 20: 20139
iodine-129 gamma emission in crystals of, Debye-Waller factor and second order Doppler shift for, (T), 20: 20150
POTASSIUM IONS
effects on carbon dioxide radical ESR, 20: 20161
reactions with silicon at 1 to 20 kev, channeling effects and penetration in, 20: 20124
POTASSIUM ISOTOPES K-39
energy levels of, parity and spin of, (T), 20: 19816 (INP-441/PL)
proton reactions (p,α) at 10 to 13 Mev, excitation functions for, (E), 20: 19902
POTASSIUM ISOTOPES K-40
abundance in meteoritic and terrestrial samples, ratio to potassium-41, (E), 20: 19341
content in human body, September 1962 to August 1963, 20: 18961
content in sediments in New Jersey Triassic Basin, age estimation from, 20: 18924(R) (NYO-1669)
POTASSIUM ISOTOPES K-41
abundance in meteoritic and terrestrial samples, ratio to potassium-40, (E), 20: 19341
energy levels from argon-40 (p,p′) reactions, fine structure of isobaric analog, (E), 20: 19905
energy levels in, fine structure of analog, (T), 20: 19930
POTASSIUM ISOTOPES K-42
decay curve for mixture of potassium-43 and, resolution of, 20: 19074
reactions with monocrystalline tungsten at 0.1 to 1.5 Mev, range distributions from, 20: 20135
POTASSIUM ISOTOPES K-43
decay curve for mixture of potassium-42 and, resolution of, 20: 19074
POTASSIUM MAGNESIUM FLUORIDES
free energy of formation, 20: 20177(R) (BNL-929, pp 83-105)
POTASSIUM MANGANESE FLUORIDES
neutron scattering by, diffuse, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
POTASSIUM NITROSODISULFONATES
radiolysis of, in aqueous solutions, yields from gamma, 20: 18767
POTASSIUM PROTACTINIUM FLUORIDES
crystal structure, 20: 19231
preparation and properties of, 20: 18681
POTASSIUM SODIUM TARTRATES
radiation effects on phase stabilization in ferroelectric, gamma, 20: 20172
radiation effects on Barkhausen effect in, gamma, 20: 20174
radiation effects on electronic phenomena in, gamma, 20: 20175
radiation effects on internal friction and piezoelectric modulus in, gamma, 20: 20173
POTASSIUM SULFATES
radioinduced ESR spectra in, at 77 and 300°K, 20: 18734
POTASSIUM SYSTEMS
Ar–K, electron temperatures in hot discharge plasma of, (E), 20: 20024
Ar–K, electron temperatures in crossed-field flow of plasma of, (T), 20: 20076
POTATOES
analysis of flour from, for mercury, mercury-197 separation in neutron activation, 20: 18595
radiation effects on, mutagenic, 20: 18409
POWDERS
surface area of, permeability techniques for measuring, 20: 19181 (SC-DC-66-1297)
POWER BREEDER REACTORS
fuel cycle studies for fast, 20: 20229(R) (ANL-7110, pp 99-229)
kinetics of fast, research progress on, 20: 20229(R) (ANL-7110, pp 99-229)
POWER BURST FACILITY
design, 20: 20312 (IDO-17060)
fuel design concepts and performance testing of, 20: 20312 (IDO-17060)
heat transfer during accidents and normal operation, 20: 20312 (IDO-17060)
safety analysis of, 20: 20312 (IDO-17060)
site description, 20: 20312 (IDO-17060)

POWER PLANTS
conference, 20: 20281
development of potassium-driven turbines for space, 20: 18881(R) (N-65-18742)
radioisotope uses in hydroelectric, 20: 19128
POWER REACTORS
control of, review of instrumentation for, 20: 20246 (RISO-M-312)
control system for Danish PHWR, regulation of, 20: 20245 (RISO-M-241)
coolant temperature monitor for, design of, 20: 20186 (DP-834)
criticality determination for gas-cooled heavy-water moderated, computer program for, 20: 20267 (UJV-1046)
criticality determination for gas-cooled heavy-water moderated, computer program for, 20: 20268 (UJV-1422)
design and development of fluidized-bed and settled-bed, 20: 20177(R) (BNL-929, pp 83-105)
design and testing of Russian thermionic, 20: 20277
design for combined conventional and thermionic energy removal, 20: 20286(P)
design of 1000-Mw(e), with handling cell, 20: 20274(T) (ORNL-tr-988)
development of pressurized water, 20: 20278
development of, role of research reactors in, 20: 20330
economics and safety, 20: 20284
fuel cycle cost calculations for, method of, 20: 20235 (EUR-2521.e)
neutron flux monitoring in, using argon gas, 20: 20206 (NAA-SR-11356)
reactivity measurements during shutdown of, noise techniques for, 20: 20241 (NYO-3122-35)
shielding for KS-150, neutron flux in, 20: 20269 (UJV-1454/65)
shutdown systems of, survey on, 20: 20243 (ORNL-NSIC-7)
site selection factors, 20: 20255 (TID-22744)
status, 20: 20282
steam generators for dual purpose, 20: 20291
POWER SUPPLIES
design for ion engines, 20: 18883 (N-65-21432)
development for synchrotron magnets, 20: 19303 (PPAD-581D)
development of solar-thermionic, for space vehicles, 20: 19421 (N-65-25406)
equipment for solar-thermionic space, ancillary, 20: 19420 (N-65-25271)
instrumentation for solar-thermionic, for space vehicles, 20: 19419 (N-65-24874)
PRASEODYMIUM
determination in nitrate solutions by conductometric titration using sodium tungstate, 20: 18608
separation from cerium or neodymium by solvent extraction using organic phosphorus compounds, 20: 18850
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
PRASEODYMIUM ALLOYS
Al–Pr, phase diagram and crystal structure of intermetallic compounds in, 20: 19247
Ge–Pr, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Pr, preparation and crystal structure of PrGe, 20: 19224
POTASSIUM CHLORIDES
B_2O_3–KCl, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
PRASEODYMIUM CHLORIDES
magnetic phases, (T), 20: 20143
PRASEODYMIUM IONS
energy levels of trivalent, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
PRASEODYMIUM ISOTOPES Pr-138
beta decay of, γ-γ angular correlations in, (E), 20: 19957
PRASEODYMIUM ISOTOPES Pr-141
gamma reactions (γ,n) at 9.125 to 24.000 Mev, cross sections for, (E/T), 20: 19820 (IS-T-78)
PRASEODYMIUM ISOTOPES Pr-143
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
energy levels from cerium-143 decay, (E), 20: 19963
PRASEODYMIUM ISOTOPES Pr-144
separation from sea water, method for, 20: 18576(R) (TID-22660)
PRASEODYMIUM OXIDES
Pr_2O_3–Tb_2O_3, phase studies, 20: 18697
PRASEODYMIUM SILICIDES
preparation and crystal structure of, 20: 19224
PRECIPITATION, ATMOSPHERIC
cesium-137 content in Colorado, 1962 through 1964, 20: 18919
radioactivity in, 1965, 20: 18914
radioactivity in, 1965, 20: 18915
radioactivity in, 1965, 20: 18918
PREGNANCY
placental localization by arteriography during, 20: 18520
radiation exposure during, frequency of, 20: 18506
PRESSURE
cellular and protein resistance to hydrostatic, effects of heavy water on, 20: 18218(T)
PRESSURE VESSELS
plug for, design of bottom, 20: 20192(P)
stress analysis and testing of EGCR, 20: 20249 (TID-22738)
stress analysis of, use of strain gages in, 20: 18880 (Y-RD-5)
PRESSURIZED WATER REACTORS
development of power, 20: 20278
development status, 20: 20219
fuel element design for, using thorium-232 and uranium-238, 20: 20223(P)
steam generation without heat exchanger, 20: 20285(P)
PROCESS HEAT REACTORS
kinetics of, computer program for, 20: 20287 (AEEW-R-453)
use for desalination, environmental factors of, 20: 20288 (BNWL-SA-596)
PRODUCTION REACTORS
coolant temperature monitor for, design of, 20: 20186 (DP-834)
PROLINE
labeling with tritium following radiolysis of ribonuclease, 20: 18749
PROMETHIUM
separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
PROMETHIUM ALLOYS
Ge–Pm, crystal structure of, at or near equiatomic proportions, 20: 19225
PROMETHIUM IONS
solvent distribution in nitric acid solutions with dodecylamine and trioctylphosphine oxide in diethylbenzene, effects of lithium nitrate on, 20: 18561 (EUR-2635.d)
PROMETHIUM ISOTOPES Pm-147
beta backscattering by, corrosion measurement on metals using, 20: 19196
use as radiation source in x-ray fluorescence analysis of ores, 20: 18593
use in preparation of self-luminescent substances, 20: 18797(P)
PROPANE
reactions of recoil carbon-11 with deuterated, yields of acetylene from, 20: 18714
reactions with deuterium and tritium ions, spectral studies on, 20: 18657
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
PROPANE, 2-METHYL-
reactions with deuterium and tritium ions, spectral studies on, 20: 18657
1,3-PROPANEDIOL, 2-AMINO-2-HYDROXYMETHYL-
properties as radiation dosimeter, 20: 18503 (AD-611869, pp 169-83)
2-PROPANETHIOL, 1-AMINO-
radiosensitivity effects on mice, mechanisms for x, 20: 18431
1-PROPANOL
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
2-PROPANOL
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
radiolysis of, effects of nitrous oxide and sulfuric acid on gamma, 20: 18766
maleic acid–2-propanol, radiolysis yields in, 20: 18730 (UJV-1468)
1-octene–2-propanol, radiolysis yields in, 20: 18730 (UJV-1468)
2-PROPANOL, 2-METHYL-
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
PROPENE
radiolysis of deuterated, in presence of hydrogen, nitric oxide, and rare gases, proton transfer in, 20: 18742
yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
PROPENE POLYMERS
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135 (K-C-718)
radiolysis of atactic and isotatic, effects of nitrous oxide on, 20: 18770
PROPIONAMIDE
N-methyl, effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
PROPORTIONAL DETECTORS
design and performance of transistorized, 20: 19016 (AD-629709)
electron multiplication in gas-filled 4π, 20: 19018(R) (ANL-7110, pp 231-310)
performance of helium-3, for neutrons, 20: 19047 (UCRL-16595)
performance of, error statistics for, 20: 19053
system of, for simultaneous alpha-beta counting, 20: 19058
use for measurement of x radiation from plutonium-239 in lungs, 20: 18186(R) (LA-3432, pp 102-29)

PROPULSION
electric systems for space, facility for testing, 20: 18885 (N-65-23253)
ion engines for space, power supplies for, 20: 18883 (N-65-21432)
ion engines for space, development of mercury-fueled, 20: 18884(R) (N-65-22975)
ion engines for space, use of oxide-coated brush cathodes in electron-bombardment, 20: 18886 (N-65-25549)
plasma jet, performance of a-c crossed field, 20: 18888
plasma jet, review of, (E/T), 20: 18887 (NASA-TN-D-3332)
PROTACTINIUM
chemistry of, review of, 20: 18638
PROTACTINIUM ISOTOPES Pa-230
alpha spectra, (E), 20: 19857
PROTACTINIUM ISOTOPES Pa-231
deposition in silts, age estimation from, 20: 18926 (NYO-3450-1, pp 29-40)
use for production of uranium-232 by irradiation, 20: 18802 (CEA-R-2917)
PROTECTIVE CLOTHING
apron design for dental roentgenography patients, 20: 18986(P)
shielding properties of space suits, 20: 18943 (N-65-21724)
PROTEINS
metabolism in chickens, tracer study, 20: 18188(R) (ORO-635)
radiation effects on deoxyribonucleohistone, 20: 18789
radiation effects on content of, in isolated carrot root cells, 20: 18395
radiation effects on papaya content, gamma, 20: 18246(R) (UH-235P5-1, pp 7-13)
radiation effects on synthesis in stem of rat brain, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiation effects on content of glyco-, in rat serum, x, 20: 18258
radiation effects on solutions of, effects of cysteamine on, 20: 18276
radiosensitivity effects of basic, in rabbits, 20: 18470
resistance to heat and hydrostatic pressure, effects of heavy water on, 20: 18218(T)
structure, 20: 18184(R) (BNL-929, pp 115-25)
synthesis in mammalian cells in culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
PROTON BEAMS
acceleration of 200-400 mamp, column design for, 20: 19299 (MURA-707)
current density measurement using tungsten gauge, 20: 19277
effects of, combined with vibrations and acceleration on shielded rats, 20: 18441
effects of, review of LET and RBE in, 20: 18362
effects on mice, effects of shielding on, 20: 18441
effects on mice, protective effects of chemical agents against, 20: 18440
effects on mouse hematopoietic tissues, 20: 18364
use of high-LET, for therapy, 20: 18507 (BNL-10009)
PROTON PAIRS
production by photons, substitution law test from coupling constants for, (T), 20: 19516
PROTONS
dosimetry using lithium-drifted silicon detectors, 20: 19031(R) (N-65-19766)
effects (RBE) of 660-Mev, 20: 18440
effects of 2.2-Bev, on mice, 20: 18185(R) (BNL-929, pp 126-47)
effects on gallium arsenide and silicon solar cells, 20: 19095 (N-65-16347)
effects on iodomethane in cyclohexene, tracer studies of, 20: 18771
effects on ionospheric absorption, 20: 19351
effects on photovoltaic parameters of silicon and gallium arsenide solar cells, 20: 19106(R) (N-65-19886)
effects on resistance of alpha-manganese at low temperatures, 20: 19269
emission from argon-33, calcium-37, and titanium-41, (E/T), 20: 20365
form factors of, electromagnetic, (E), 20: 19526
gyrofrequency near satellite, proton-whistler determination of, (E), 20: 19669
interactions at high energies, polarization in, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions at 2.4 to 2.85 Bev, mesons (K^+) spectra from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with mesons (K) and (π), 2+ meson exchange in, (T), 20: 19512
interactions of, analyticity test for amplitudes in complex angular momentum plane, 20: 19567
interactions of, mechanisms of deuteron, meson (π^+), and neutron production in, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with deuterons, review of, 20: 19982
interactions with neutrons, charge exchange model for, 20: 19273(R) (BNL-929, pp 3-43)
interactions with mesons (π^-) at 8 to 24 Bev, forward amplitudes for, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with meson (π) at 4 to 12 Bev, elastic, (E), 20: 19273(R) (BNL-929, pp 3-43)
interactions with mesons (K^-) at high energies, resonances from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
interactions with antineutrinos, meson (II) production cross sections for, (E), 20: 19438 (ANL-7130, pp 257-71)
interactions with mesons (π^-) and (π^+) above 2.5 Bev/c, meson (A_1), (A_2), and (B) production in, (E), 20: 19449 (UR-875-123 and (Add.))
interactions with protons at 204 Mev, bremsstrahlung production cross sections for, (E), 20: 19452 (UR-875-126, Paper 4)
interactions with neutrons at 205 Mev, polarization parameters of, (E), 20: 19453 (UR-875-126, Paper 5)
interactions with neutrons at 605 Mev, elastic, (E), 20: 19441 (JINR-E-2560)
interactions with protons at 23.1 Mev, phase shift analysis for, (E), 20: 19442 (JINR-E-2609)
interactions with neutrons at 23.1 Mev, phase shift analysis for, (E), 20: 19442 (JINR-E-2609)
interactions with protons, peripheral model for deuteron production in, 20: 19466
interactions with mesons (π^-), peripheral model for Y_1^* resonance production in, 20: 19469
interactions with mesons ($\pi^\pm$), sum rules for real part of forward amplitude for, 20: 19470
interactions with mesons ($\pi^\pm$), above 2.9 Bev, polarization in, (T), 20: 19473
interactions with hyperons (Λ) at 40 to 250 Mev, effect of hard core on cross sections for, (T), 20: 19475
interactions with mesons (π^-) at 2 to 12.4 Bev/c, differential cross sections for elastic, (T), 20: 19483
interactions with mesons (π^-) at 2.01 to 2.08 Bev/c, polarization in elastic, (T), 20: 19484
interactions with mesons (π^-), $KN\Lambda$ and $KN\Sigma$ coupling constant ratio from baryon exchange in, (T), 20: 19487
interactions with protons, cross section for quark production in, (T), 20: 19494
interactions with mesons (π^-) at 365 Mev, recoil-proton polarization in elastic, (E), 20: 19495
interactions with antiprotons at 3.0 to 4.0 Bev/c, cross sections for charge-exchange, (E), 20: 19497
interactions with antiprotons at 5.7 Bev/c, four-pion production in annihilation, (E), 20: 19498
interactions with protons in (He-3,2p) reactions with helium-3, final-state, (E/T), 20: 19500
interactions with protons at 0.75 to 2.80 Bev, polarization in elastic, (E), 20: 19502
interactions with neutrons, amplitude for elastic, (T), 20: 19504
interactions with mesons (π) at 1 to 3 Bev/c, proton polarization in elastic, (E/T), 20: 19505
interactions with nucleons, 2+ meson exchange in, (T), 20: 19512
interactions with mesons (π^-) at 39 Mev, charge-exchange and elastic, (E), 20: 19515
interactions with protons, meson–nucleon coupling constants from p-wave amplitudes for, (T), 20: 19521
interactions with electrons, differential cross sections for elastic, (E), 20: 19526
interactions with mesons (K^-), $KN\Lambda$ and $KN\Sigma$ coupling constant ratio from baryon exchange in, (T), 20: 19487
interactions with deuterons and protons at 140 Mev, cross sections for bremsstrahlung production in, (E), 20: 19496
mass relative to neutrons, (T), 20: 19508
meson (μ) scattering by, angular distributions from, (E/T), 20: 20365
polarization in hydrated magnesium lanthanum neodymium nitrate crystals, dynamic, 20: 20166
reactions (p,α) with nitrogen-15 at 6.70 to 15.16 Mev, cross sections for, (E), 20: 19818 (INSJ-95)
reactions (p,α) with oxygen-16, angular distributions from, (T), 20: 19967
reactions (p,α) with oxygen-18 in quartz, diffusion from, 20: 20127
reactions (p,α) with potassium-39 at 10 to 13 Mev, excitation functions for, (E), 20: 19902
reactions (p,$\alpha\gamma$), (p,γ), and (p,p'γ) with aluminum-27 at 4.0 to 6.7 Mev, cross section fluctuations for, (E), 20: 19814 (IKF-15)
reactions (p,d) with calcium-40, chromium-52, and nickel-60 at 55 Mev, angular distributions and spectroscopic factors from, (E), 20: 19877
reactions (p,γ) with sulfur-34 at 1.9 to 3.0 Mev, chlorine-35 resonance levels from, (E), 20: 19973
reactions (p,γ) with monocrystalline aluminum, orientation dependence of yields from, (E), 20: 20130
reactions (p,γ) with vanadium-51 at 0.6 to 2.7 Mev, isobaric analog resonances in chromium-52 from, 20: 19928
reactions (p,n) with nuclei, charge exchange properties of, (E/T), 20: 19838 (UCRL-14760-T)
reactions (p,n) with iron-58, cobalt-58 levels from, (E), 20: 19859
reactions (p,n) with chlorine-37 at 3.0 to 5.5 Mev, angular distributions

and gamma yields from, (E), 20: 19891
reactions (p,n) with nickel-58, 202-kev level from, (E), 20: 19914
reactions (p,pα) with carbon-12 at 660 Mev, cross sections for, (E), 20: 19977
reactions (p,t) with nuclei, two-nucleon transfer theory for, 20: 19926
reactions with atomic hydrogen, probability of electron capture in, (T), 20: 19384
reactions with beryllium, lead, tin, and uranium at 0.5 to 2 Bev, neutrons from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
reactions with copper-63 and copper-65 at 1 Bev, recoil angular distributions from, 20: 18556(R) (BNL-929, pp 66-82)
reactions with copper at 2.5 Mev, radiation damage and temperature effects on channeling, 20: 20132
reactions with lead and uranium at 2.9 to 28 Bev, yields from, 20: 18556(R) (BNL-929, pp 66-82)
reactions with magnesium and sodium, ionization cross sections for, (T), 20: 19400
reactions with molybdenum at 340 Mev, separation of technetium from products from, 20: 18843
reactions with nitrogen at 13 Mev, cross sections for, (E), 20: 19941
scattering by aluminum, potentials from second-order multiple scattering theory elastic, 20: 19933
scattering by argon-40, isobaric analog resonance fine structure from elastic, (E), 20: 19905
scattering by calcium-48 at 10 Mev, angular distributions from inelastic, (E), 20: 19929
scattering by carbon-12 at 7.85 Mev, cross sections for inelastic, (T), 20: 19823 (JINR-P-2431)
scattering by carbon-12 over 5.3- and 6.6-Mev anomalies, complex phase shifts for elastic, (T), 20: 19922
scattering by fluorine-19 at 13.9 Mev, excitation of ground-state rotational band in, (E/T), 20: 19921
scattering by helium-4 at 660 Mev, cross sections for elastic, (E), 20: 19977
scattering by helium-3 and -4 at 660 Mev, mechanisms for elastic, (E/T), 20: 19978
scattering by helium at 0.3 to 200 ev, cross sections for elastic, 20: 19365
scattering by monocrystalline aluminum and tantalum, orientation dependence of yield of Rutherford, (E/T), 20: 20131
scattering by nuclei at 20 Bev, cross sections for elastic, (E), 20: 19901
scattering by nuclei at 95 to 300 Mev, differential cross sections and polarization from second-order multiple scattering theory elastic, 20: 19933
scattering by strontium-88, energy level studies from, (T), 20: 19826 (MIT-2098-229)
scattering by zirconium-94, angular distributions and j values for analog states from inelastic, (E), 20: 19917
temperature in solar wind, measurement of, (T), 20: 19349
temperature in solar wind, measurement of, (T), 20: 19350
transfer in radiolysis of deuterated hydrocarbons, 20: 18742

PROVIDENCIA MINE (MEXICO)
geology and mineralogy of, 20: 18631 (NYO-2266-1)

PSEUDOUREA, 2-(2-AMINOETHYL)-2-THIO-
complex formation with metalloenzymes in mouse cells, 20: 18450
cyclic analogs of, radiosensitivity effects in mice, 20: 18484
effects on body water and sodium balance in rats, 20: 18458
effects on irradiated mice, delayed toxic, 20: 18488
effects on normal tissues and tumor growth, 20: 18475
effects on phosphorus-32 and sulfur-35 uptake by bone, 20: 18479
effects on response of rat blood pressure to adrenaline and acetylcholine, 20: 18239
radiosensitivity effects in mice, γ, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiosensitivity effects on mice during simulated space flight, gamma, 20: 18443
radiosensitivity effects of, reaction mechanisms for, 20: 18450
radiosensitivity effects in rats, 20: 18458
radiosensitivity effects on rabbit eyes, 20: 18476
radiosensitivity effects in mice, 20: 18488
radiosensitivity effects on mice, effects of DNA on, 20: 18492
reactions with free radicals in biological systems, 20: 18479

PSYCHOLOGY
conditioned and avoidance behavior of primates, motivation of, 20: 18283 (AD-611869, pp 375-89)

PUERTO RICO POWER REACTOR
startup and operation of, summary of, 20: 20234 (CEND/PRWRA-257A)

PULSE ANALYZERS
design of fast single-channel, 20: 19027 (N-65-16588)
design of sequential signal selector system, for isotopic analysis of water using infrared absorption, 20: 18620(P)
design of time-amplitude converter using semiconductor elements, 20: 18992 (LNF-65/46)
design of two-parameter, 20: 19067
operating program for AI-100-1, for short-lived activities, 20: 19064
use in multiparameter analysis, 20: 18988(R)(ORNL-929, pp 58-66)

PULSE TRANSFORMERS
design of 104-amp, for solenoids, 20: 20019 (UCRL-14511-T(Rev.1))

PUMPS (LIQUID METAL)
design and performance of lithium, 20: 18857

PUREX PROCESS
waste fixation in, computer program for glass composition for, 20: 20346 (ORNL-3824)
waste processing by evaporation and denitration, performance of equipment for, 20: 20344 (BNL-10047)

PURINES
radiosensitivity effects in DNA, x, 20: 18256

PYRAZOLINES
radiosensitivity effects on pulmonary tissues, 20: 18543

PYRIDINE
methanol–pyridine, radiolysis of, yields of hydrogen from gamma, 20: 18736
pyridine–H_2O, radiolysis of, yields of hydrogen from gamma, 20: 18736

PYRIDINE-1-OXIDE
complexes with uranyl chlorides, preparation, infrared spectra, and magnetic susceptibility, 20: 18684

2,6-PYRIDINEDICARBOXLYIC ACID
complexes with alkaline earth metals, ion exchange properties of, 20: 18685

PYRIDOXINE
preparation and NMR spectra of deuterated pyridoxals, 20: 18718

PYRIMIDINES
labeling with tritium, 20: 18719
radiolysis of, 20: 18295(R) (UCLA-12-576, pp 27-56)

PYROPHOSPHATES
radiosensitivity effects in mice, 20: 18473

PYROSULFITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

Q

QUANTUM ELECTRODYNAMICS
electron infraparticle structure in, Block-Nordsieck model for, 20: 19711
photon field coherence in, nth-order, 20: 19718
testing at small distances, review of, 20: 19529

QUANTUM MECHANICS
differential equations in, Cauchy problem for coupled Dirac and Maxwell, 20: 19703
operator fields in nonrelativistic, differential conservation laws for, 20: 19717
operators in, error bounds for expectation values of unbounded, 20: 19706
statistics of isotope effects, (E/T), 20: 18656
theory of, gravitational effects in, 20: 19602
uncertainty principle for relativistic rigid bodies in, 20: 19700
wave equation with simple potential, finite-difference approximation solution for Schroedinger, 20: 19699 (UCRL-14643-T)
wave equations for arbitary spin in, two-component and Dirac-like form, 20: 19712
wave equations for central fields in, corrector formula for solutions of Schroedinger, 20: 19715
wave equations in, Green function estimation of Schroedinger-operator in, 20: 19702
wave equations in, relations between Hamilton-Jacobi and Schroedinger, 20: 19719

QUARTZ
analysis for copper, manganese, sodium, and zinc, activation, 20: 18631 (NYO-2266-1)
diffusion of oxygen-18 in, proton bombardment method for study of, 20: 20127
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
radiation effects on color of, gamma, 20: 19261

QUINOXALINE
di-N-oxide, radiosensitivity effects in dogs and mice, 20: 18465

R

RABBITS
effects of cyclohexanol succinate on bone marrow of, effects of lysozyme on, toxic, 20: 18470
gamma counting rate in blood plasma of, effects of biological differentiation of molybdenum-99 and technetium-99 on, 20: 18213
muscle relaxation in, after ATP-induced contraction, 20: 18228
radiation effects combined with labyrinthectomy on nervous system in,

20: 18338
radiation effects on histology in ears of, sieve-controlled x, 20: 18357
radiation effects on lipid metabolism in, x, 20: 18375
radiation effects on smallpox immunity in, x, 20: 18408
radiation effects on, physiological, 20: 18188(R) (ORO-635)
radiation effects on serotonin levels in blood of, x, 20: 18257
radiation effects on cytochrome c in, x, 20: 18261(T)
radiation effects on heart arteries and muscle of, x, 20: 18456
radiation injuries of eyes of, protective effects of chemical compounds against, 20: 18476
radiosensitivity of, effects of oil and wax suspension of serotonin on, 20: 18487
radiosensitivity of bone marrow of, effects of cyclohexanol succinate and lysozyme on, 20: 18494
technetium-99 distribution in tissues of, 20: 18509(R) (UCLA-12-576, pp 61-80)
uptake of phosphorus-32-chromic phosphate by lymph nodes of, effect of Freund adjuvant on, 20: 18241

RADIATION

distribution in tissues during space flight, 20: 18290(R) (N-65-16483)
dosage to cancer patients, methods of optimizing, 20: 20360(R) (PRNC-73)
dosimetry of, equation for internal, 20: 18955
effect on ice nucleation in supercooled water, 20: 19073
effects of ionizing, on coalescence, 20: 20365
effects of pulsed, on aqueous solutions of potassium ferrocyanide, 20: 18769
effects on activity of glutamic dehydrogenase and glutamic-oxalacetic transaminase in mouse spleen tissue, 20: 18280
effects on adrenal glands of rats, 20: 18402
effects on agricultural plants, 20: 18409
effects on animals and plants, biological, 20: 20367
effects on biological systems, molecular transfer of energy in, 20: 18274
effects on blood vessels following tumor therapy during infancy, 20: 18398
effects on bone marrow function after therapy of genital and mammary carcinomas, 20: 18552
effects on cobalt-58 retention in tris(ethylenediamine)cobalt(III) nitrate in aqueous solutions and solid state, 20: 18725 (IS-T-73)
effects on deuterated cyclohexane, 20: 18733
effects on dielectric constants and paraelectric susceptibility of polyethylenes and polystyrene, 20: 19266
effects on DNA activation of hepatic catalase, 20: 18279
effects on DNA synthesis, time intervals for fractionated-dose, 20: 18278
effects on ferrous solutions containing sulfuric acid, yields of products formed by, 20: 18745
effects on fertility of female caterpillars, 20: 18329
effects on gastrointestinal tract, role of bile in developing, 20: 18327(T)
effects on grain, review of, 20: 19123
effects on growth and morphology of plants at thermonuclear test site, 20: 18386
effects on insects, review of, 20: 19123
effects on leukocyte chromosomes, 20: 18307
effects on metabolism and viability of bacteria, 20: 18509(R) (UCLA-12-576, pp 61-80)
effects on mine stability and plastic flow in salt deposits, 20: 18897 (ORNL-P-2006)
effects on mouse sensitivity to pertussis antigen-antibody complex, 20: 18282
effects on myelin synthesis in rat brain, 20: 18295(R) (UCLA-12-576, pp 27-56)
effects on pelvic cancer following ovarian radiocastration, 20: 18397
effects on Pisum meal, protective effects of water against, 20: 18429
effects on plant biochemistry, review of large-dose, 20: 18277
effects on plants, genetic, 20: 18420
effects on polymerization of inclusion compounds, 20: 18784(T)
effects on potassium chloride crystals, computer-simulated kinetics of Varley mechanism for F centers from, 20: 20142
effects on pulmonary tissue following thoracic cancer radiotherapy, 20: 18305
effects on rat erythropoiesis, effects of erythropoietin on, 20: 18500
effects on reproductive capacity of Rous viruses, 20: 18321
effects on sedimentation rates in bismuth oxychloride, 20: 18792
effects on semiconductor integrated microelectronic circuits, 20: 19093(R) (AD-629948)
effects on silicon, types of, 20: 19104(R) (N-65-19867)
effects on silicon, effects of impurities on, 20: 19106(R) (N-65-19886)
effects on sodium chloride crystals, symmetry of N centers from, 20: 20159
effects on spores of *Bacillus megaterium*, effects of hydrogen sulfide and nitric oxide on, 20: 18434
effects on TBP during fuel processing, prevention of, 20: 18800(P)
effects on tetrahydronaphthalene, excited and superexcited states in, 20: 18783
effects on thermoluminescence in molecular crystals, 20: 18759
effects on transistor performance, 20: 19099(R) (N-65-17954)
effects on 2N918 transistors, IN250 diodes, and tantalum capacitors, 20: 19103 (N-65-19758)
emission by sources moving at superphase velocity of scalar and vector fields, (T), 20: 19458
measurement of low-level, modulation method for background suppression in, 20: 19081
production and industrial uses of, bibliography on, 20: 19117 (ORNL-TM-1356(Suppl.1))

RADIATION CHEMISTRY

gamma source for use in, 20: 18732
nuclear reactions in, review of uses of secondary, 20: 18807
radioinduced reactions and yields in, comparison of experimental and theoretical, 20: 18556(R) (BNL-929, pp 66-82)
research programs for fissio chemical processes, 20: 20183
research at GRR-1 facility, 20: 20337

RADIATION DETECTION INSTRUMENTS

book: *Nuclear Physics Detection Instruments and Their Application*, (In Chinese), 20: 19086
calibration, development, and maintenance, 20: 20358(R) (JAERI-5014)
design for detection of trapped particles using Mariner C, 20: 19034(R) (N-65-27827)
resolution time losses in, circuits for determining, 20: 19036 (NP-15766)

RADIATION DETECTION INSTRUMENTS (PULSE TYPE)

dead-time errors for, equation for, 20: 19082
design and performance of G-M, for floor monitoring, 20: 19065
design and performance of, for radiodiagnosis and radiotherapy, 20: 19084
design of automatic range changing, for area gamma monitoring, 20: 19017 (AECL-2533)
design of 8-decade G-M, for gamma monitoring, 20: 19068
development for low-energy particles and high-energy photons, 20: 19032(R) (N-65-23928)
gain stabilization in scintillation, control circuit for, 20: 19083
performance of, error statistics for, 20: 19053
performance of, statistics for, 20: 19851

RADIATION DETECTORS

design and performance of, for low-level alpha detection, 20: 19057
development for neutron monitoring, 20: 20183
development of supercooled-liquid, 20: 19073
performance of secondary emission, for electron beams at 10 Mev to 5 Bev, 20: 19024 (DESY-65/16)

RADIATION INJURIES

chemical and physical mechanisms of, research on, 20: 18198
diagnosis of, use of incidence of binucleated lymphocytes for, 20: 18399
dose concept for γ, effective-residual, 20: 18289(R) (LA-3432, pp 56-101)
evaluation of, computer program for, 20: 18509(R) (UCLA-12-576, pp 61-80)
mechanisms of lethal, in cells, 20: 18405
mechanisms of, role of molecules in, 20: 18274
pathology of delayed, in mice and rats, 20: 18376
pathology of spinal cord, induced by therapy, 20: 18406
physiological effects of, in rabbits, rats, and sheep, 20: 18188(R) (ORO-635)
protection against, effects of bacterial toxins in mice on, 20: 18425
protection against, reaction mechanisms for MEA and MEG in, 20: 18450
protection against, using amines in mice, 20: 18454
protection against, using nicotinamide, 20: 18455
protection against, using cysteamine in rats, 20: 18457
protection against, using AET in rats, 20: 18458
protection against, using drugs affecting nervous system in mice, 20: 18459
protection against, using quinoxaline-di-N-oxide in dogs and mice, 20: 18465
protection against, techniques for evaluation of chemical, 20: 18471
protection against low-dose, using chemical compounds, 20: 18473
protection against, using thioglycollic acid derivatives in mice, 20: 18474
protection against, using methandrostandiol in mice and rats, 20: 18477
protection against, using nitrated procainamide derivatives in mice, 20: 18478
protection against, using pantothenic acid in mice, 20: 18486
protection against, using AET and DNA in mice, 20: 18492
protection against, using homologous injected DNA in rats, 20: 18495
protection against, using bacterial toxins in mice, 20: 18496
repair of animal-cell, effects of radioprotective and radiosensitizing, compounds on, 20: 18444

RADIATION MONITORING

equipment design for alpha, 20: 19057

equipment design for β-γ, 20: 19065
equipment for area gamma, automatic range changing, 20: 19017 (AECL-2533)
equipment for, design and performance of transistorized, 20: 19016 (AD-629709)
equipment for, design of improved G-M, 20: 19059
method for food, 20: 18976
method for radium-leak, 20: 18982
program at Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)
program in Japan, 20: 18921

RADIATION PROTECTION
medical facilities for, at San Piero, 20: 18963
methods for acute fallout, 20: 18980
review, 20: 20367
standards for, Federal Radiation Council, 20: 18980
system at Japan Atomic Energy Research Inst., 20: 20358(R) (JAERI-5014)

RADIATION SICKNESS
effects of antiemetic drugs during, 20: 18549
effects on hypoxia in rats, 20: 18272
etiology of, 20: 18549
role of bile in gastrointestinal syndrome of, 20: 18327(T)
therapy in man using pyridine diphosphate nucleotides, 20: 18535

RADIATION SOURCES
preparation and shipment of BNL, 20: 20177(R) (BNL-929, pp 83-105)
preparation by isotope separation, 20: 19166
preparation of ThB + C + C', device for, 20: 18806

RADIATION TARGET CANS
use for measuring transient steam-void formation in water-cooled reactors, (E), 20: 20179(R) (STL-372-27, pp 3-12)

RADIATION TARGETS
charged-particle scattering by spin-0, spin-1, (T), 20: 19924
conference on accelerators, for production of neutrons, 20: 19296 (EUR-2641.d,f,e)
cooling system design for, 20: 18877
electron beam scattering from thick, retrofugal flux from, (E), 20: 19394
preparation at ORNL, 20: 19153
preparation of carbon-13, 20: 19946
preparation of deuterated polyethylene, 20: 18692
preparation of isotope, performance of mass spectrometers for, 20: 19167
preparation of thin-foil metal-isotope, 20: 19297 (IAE-973)
preparation using electromagnetic isotope separator, 20: 19151
preparation using Seibersdorf isotope separator, 20: 19164

RADIO ASTRONOMY
radio-source detection methods in, interferometric, 20: 19348

RADIO WAVES
absorption in auroral zone, electron precipitation correlation with, (E), 20: 19685
emission from atomic explosions, computer programs for calculating, 20: 18927 (RM-4942(RAND))
emission from sun in burst events, corona property determination from, 20: 19355
phase perturbations of v-l-f, from Soviet high-altitude explosion, 20: 19677
sources of, identification of quasi-stellar, 20: 19340

RADIOACTIVE CONTAMINATION
control of, for commercial aircraft, 20: 18959
determination in water supplies, method for, 20: 18615
dosimetry of, cobalt-60, 20: 18957

RADIOACTIVE MATERIALS
distribution in compartmental biological systems, stochastic models for, 20: 18427 (ORNL-3920)
shipping regulations for, 20: 18940 (EUR-2747.f)

RADIOACTIVITY
effects on thermoelastic stresses below Earth's crust, 20: 18899
measurement of low-level, modulation method for background suppression in, 20: 19081

RADIOAPPLICATORS
design and performance of cobalt-60, for intravaginal irradiation, 20: 18511
design and performance of extracorporeal strontium-90–yttrium-90, 20: 18522
dosimetry for gamma, 20: 18531
use for therapy, review, 20: 18555
use of strontium-90–yttrium-90, for pituitary destruction, 20: 18532

RADIOBIOLOGY
charge transfer effects in radiosensitivity, mechanism of, 20: 18245 (SGAE-BL-16/1965)
distribution of radioactive material in compartmental systems, stochastic models for, 20: 18427 (ORNL-3920)
leukocyte test in, statistical reliability of, 20: 18394
research in agronomy, using reactors, 20: 20342
research in, using reactors, 20: 20341

RADIOCHEMICAL PROCESSING PLANTS
economics of precipitation-ion exchange, for waste solutions, 20: 20349
iodine-131 release at, human and milk contamination by, 20: 18983

RADIOCHEMISTRY
research at GRR-1 facility, 20: 20337

RADIODIAGNOSIS
dosimetry for, equation for internal, 20: 18955
effects on leukocyte chromosomes, 20: 18307
equipment for radiation detection in, 20: 19084
use of labeled inorganic compounds in, 20: 18529

RADIOFREQUENCY SPECTROMETERS
data recording systems for ESR, on-line analog computer, 20: 19039 (RISO-M-233)

RADIOGRAPHY
collimator for thyroid, design and performance of multiple-field, 20: 19052
contrast medium for bronchial, assessment of Hytrast, 20: 18517
effects of diagnostic, on development of fetuses and babies, 20: 18536
frequency of dental and medical, during pregnancy, 20: 18506
image intensification during diagnostic, use of tantalum screens for, 20: 18518
protection of patients during dental, apron for, 20: 18986(P)
radiation dose to skin from, methods for measuring, 20: 18505
television equipment for diagnostic, 20: 18510
use for placental localization, 20: 18520
uses of neutron, 20: 18185(R) (BNL-929, pp 126-47)

RADIOISOTOPES
absorption through skin, research on, 20: 18198
activity coefficients of, measurement of, 20: 19018(R) (ANL-7110, pp 231-310)
book: *Summary of Curietherapy*, 20: 18555
decay curves for, intercept method for resolution of two-component, 20: 19074
deposition on platinum anode, effects of hydrogen ion concentration on, 20: 18676
detection and measurement, 20: 19091
determination by autoradiographic measurement of half life using ring oven methods, 20: 18584
determination in water supplies, methods for, 20: 18615
determination of alpha-emitting, in fallout, Oct. 15 to 29, 1965, 20: 18910
determination of trace, in marine animals and plants off Puerto Rico, 20: 20360(R) (PRNC-73)
equilibration in two-compartment exchange systems, model for, 20: 18651
excretion of, chelating agents for promoting, 20: 18438
injection into petroleum deposits to supply heat and improve fluidity, 20: 19131(P)
production and handling at GRR-1 facility, 20: 20339
production and industrial uses of, bibliography on, 20: 19117 (ORNL-TM-1356(Suppl.1))
production and industrial uses of, conference on, 20: 19128
production and uses in Soviet Union, 20: 20182(T) (AEC-tr-6700)
production at SORIN, survey of, 20: 18804 (SORIN-34)
production in Mol BR-2 reactor, 20: 19139
production in RA research reactor, 20: 20340
production of short-lived, using cyclotrons, 20: 18515
production using sector-focused cyclotrons, 20: 19312
separation of, ion sources for fast electromagnetic, 20: 19143
shipments for fiscal year 1965, AEC customer lists of, 20: 19116 (ORNL-IIC-6)
toxicity of, research programs on, 20: 18198
uptake by man, research on dietary, 20: 18198
use in poultry research, review, 20: 18236
use of inorganic compound-incorporated, medical, 20: 18529
uses for determining transition temperatures of crystal systems, 20: 18677
uses in radiotherapy, 20: 20360(R) (PRNC-73)
uses of short-lived, in medicine, 20: 18198

RADIOLOGICAL DEFENSE
target analysis for exposure potential at various times, 20: 18938 (AD-629784)

RADIOLOGY
electromagnetic radiation use in, particle-wave dualism effects on, 20: 18546

RADIOMIMETIC SUBSTANCES
effects on bacteria, 20: 18481
effects on growth of cells in tissue culture, 20: 18462
effects on rat bone marrow, cytological, 20: 18534
effects on tumor-bearing mice, 20: 18475

RADIOPROTECTIVE COMPOUNDS
development of, review, 20: 18428

effects of cyclic analogs of AET in mice, 20: 18484
effects of mercaptan, reaction mechanisms in, 20: 18450
effects of methandrostandiol in mice and rats, 20: 18477
effects of organophosphorus, 20: 18482
effects of psychotropic, in mice, 20: 18501
effects of thiol, reaction mechanisms in, 20: 18453
effects of, effects of biological and physical factors on, 20: 18472
effects of, evaluation of, 20: 18471
effects of, reaction mechanisms in, 20: 18449
effects of, review, 20: 18238
effects on animal cells, reaction mechanisms for, 20: 18444
effects on mice, 20: 18440
effects on normal tissues and tumor growth, 20: 18475
effects on phosphate release and reproduction of yeast, 20: 18503 (AD-611869, pp 169-83)
evaluation of, standardization of tests for, 20: 18472
evaluation of, test systems for, 20: 18485
mechanisms for mercapto and sulfur, 20: 18274
review of efficiency, 20: 18362
synthesis of glycidic esters and organic disulfides for testing as, 20: 18424
testing in yeast, 20: 18503 (AD-611869, pp 169-83)

RADIOSENSITIVITY
charge transfer effects in, mechanism of, 20: 18245 (SGAE-BL-16/1965)
determination of host, by radiation effects on cervical carcinoma cells, 20: 18330
effects of actinomycin D and 5-fluorouracil on lung carcinoma, 20: 18539
effects of actinomycin in lung cancer, 20: 18541
effects of age on rat kidney, 20: 18284 (AD-629512)
effects of antimetabolite and cytotoxic drugs on carcinoma, 20: 18377
effects of carotenoid pigments on bacterial, 20: 18361
effects of colchicine derivatives and urethan on mouse, 20: 18467
effects of colchicine, podophyllin, and urethan on, of tumors, 20: 18537
effects of cyclohexanol succination bone marrow, 20: 18494
effects of cysteamine on yeast, 20: 18372
effects of cysteine and oxygen on *Serratia marcescens* x, 20: 18448
effects of developmental stage on Neurospora, 20: 18297(R) (UCLA-12-576, pp 81-8)
effects of drugs on animal and tumor, 20: 18238
effects of drugs on tumor, 20: 18464
effects of genetic constitution, developmental stage, temperature, and dose rate on plant, 20: 18420
effects of iodoacetamide on bacterial, x, 20: 18446
effects of iodoacetic acid on erythrocyte, 20: 18468
effects of low-temperature on *Artemia salina* oocyte, x, 20: 18447
effects of pyridine diphosphate nucleotides on, in man and rats, 20: 18535
effects of pyrozoline on pulmonary tissue, 20: 18543
effects of quinoxaline-di-N-oxide on dog and mouse, 20: 18465
effects of radiomimetic substances on bronchial tumors, 20: 18534
effects of sodium cyclohexylsuccinate on tumor, 20: 18538
effects of sodium cyclohexylsuccinate on tumor, 20: 18542
effects of species on Clostridium spore, 20: 18340
effects of water content on grass seed, 20: 18382
effects of 5-bromodeoxyuridine on lymphoma, 20: 18445
effects of 5-fluorouracil in stomach cancer, 20: 18540

RADIOSTERILIZATION
pilot plant for grain, in Savannah, 20: 19124
pilot plant for grain, in Turkey, 20: 19125
review of fruit and vegetable, 20: 18277
status of grain, 20: 19123

RADIOTHERAPY
book: *Summary of Curietherapy*, 20: 18555
developments in neutron capture, 20: 18508 (BNL-10038)
dosimetry for malignant-tumor, using linear programming, 20: 18524
dosimetry for, equation for internal, 20: 18955
dosimetry in interstitial, using radiogold seeds, 20: 18531
dosimetry in, effects of body contours on, 20: 18553
effects of actinomycin D and 5-fluorouracil on lung carcinoma, 20: 18539
effects of actinomycin on lung cancer, 20: 18541
effects of colchicine, podophyllin, and urethan on tumor, 20: 18537
effects of drugs on, 20: 18238
effects of sodium cyclohexylsuccinate on tumor, 20: 18538
effects of sodium cyclohexylsuccinate on tumor, 20: 18542
effects of 5-fluorouracil on stomach cancer, 20: 18540
effects on cathepsin, inactivation, 20: 18244 (NIJS-R-467)
effects on leukocyte chromosomes, 20: 18307
equipment for radiation detection in, 20: 19084
evaluation of thoracic, 20: 18305
feasibility of meson (π^-), 20: 18516
inflammation induced by, effects of pyrozoline on, 20: 18543
procedure for angioma, 20: 18528
procedure for cervical cancer, 20: 18550
radioisotope uses in, 20: 20360(R) (PRNC-73)
side effects of, in cancer patients, 20: 20360(R) (PRNC-73)
technique for tumor, 20: 18521
use of high-LET radiations for, 20: 18507 (BNL-10009)
use of labeled inorganic compounds in, 20: 18529
use of supervoltage radiation for rotational, of tumors, equipment and methods for, 20: 18423(R) (ACRH-24, pp 125-34)
use with chemotherapy for tumors, 20: 18464

RADIUM
content in military surplus commodities, survey of, 20: 18984
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
control at county level, 20: 18982
control of medical, in Pennsylvania, 20: 18981
effects in man, 20: 18198
effects of, combined with cobalt-60 or x rays on cervical cancer, 20: 18309
effects of, combined with x radiation on cervical cancer, 20: 18550
effects on keratinization in squamous cell carcinomas following radiotherapy, 20: 18255
use for therapy of reticulosarcoma of mediastinum, late pathological effects, 20: 18519

RADIUM ISOTOPES Ra-223
plasma and renal clearance in man, 20: 18226

RADIUM ISOTOPES Ra-226
content in Azov Sea and lagoons, 20: 18905
content in cigarettes, 20: 18965
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
content in thyroid glands of cattle, effects on analysis for iodine-131, 20: 18971
dosimetry of, equation for internal, 20: 18955

RADON
preparation of, health physics aspects of, 20: 18956

RADON ISOTOPES Rn-214
alpha decay energy of, effect of shell structure on, (T), 20: 19848

RADON ISOTOPES Rn-219
determination in air, series decay chambers for, 20: 18904

RADON ISOTOPES Rn-222
effects of inhaled, on animals and man, 20: 18198
injection in monocrystalline tungsten, alpha emission from, 20: 20129

RAIN WATER
cadmium-109 content of, New Zealand, 1964, 20: 18911
geochemistry of bromine, chlorine, and iodine in, in Hawaii, 20: 18202 (NYO-3450-1, pp 185-201)
radiation monitoring of, in Japan, 20: 18921
sodium-22 content in, at Livourne, Italy, 20: 18907

RAMAN EFFECT
detection in x-ray scattering, 20: 18559 (CALT-221-14)

RARE EARTH ALLOYS
Ag–rare earth, preparation from amalgams by heating, 20: 19185
Au–rare earth, preparation from amalgams by heating, 20: 19185
Hg–rare earth–transition metal, preparation of rare earth–transition metal alloys by heating, 20: 19185
rare earth–transition metal, preparation from amalgams by heating, 20: 19185

RARE EARTH CHROMATES(III)
preparation and properties of single-crystal, 20: 18654

RARE EARTH MINERALS
nomenclature for, system of, 20: 18898

RARE EARTHS
analysis for yttrium by x-ray fluorescent spectrometry, 20: 18611
analysis of mixtures of, by magneto-optical rotation spectroscopy, 20: 18585
content in eclogites from Nowa Wies in region of Snieznik Klodzki, Poland, 20: 18900
determination by magneto-optical rotation spectroscopy, 20: 18585
determination in nitrate solutions by conductometric titration using sodium tungstate, 20: 18608
diffusion in tantalum, isotope-separator on-line preparations for radioactive, 20: 20138
effects on *Phaseolus vulgaris*, 20: 18237
separation from other elements by ion exchange chromatography, 20: 18827
separation from thorium and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
separation of dysprosium and gadolinium from, by partition chromatography using *bis*(2-ethylhexyl) phosphate, 20: 18837
structure of, electron, 20: 20365

RARE GAS COMPOUNDS
preparation and properties of, review on, 20: 18623 (CEA-Bib-58)

RARE GASES
deuterium and hydrogen molecular beam scattering on, velocity

dependence of total cross section for, (E), 20: 19378
properties of, review on, 20: 18623 (CEA-Bib-58)
purification system development for, 20: 19190(R) (N-65-22168)
RATE METERS
design and performance of, for low-level alpha detection, 20: 19057
design of G-M, for increased range, 20: 19059
performance of, statistical errors for, 20: 19851
RATS
blood pressure of, effects of acetylcholine on, 20: 18239
body water and sodium space in, effects of AET on, 20: 18458
cholesterol and sodium octanoate oxidation by liver mitochondria in, effects of water-d_2 on, 20: 18217
contamination in, methods for eliminating cobalt- and zinc-65, 20: 18216
effects of chemicals on erythropoiesis in, effects of erythropoietin on, 20: 18500
effects of cortisone on calcium-45 uptake by bones of, 20: 18480
effects of radioactive mercurial diuretics, pathological, 20: 18295(R) (UCLA-12-576, pp 27-56)
hypertension in, effects of genetics and sodium salts on, 20: 18185(R) (BNL-929, pp 126-47)
leukocyte test in irradiated, statistical reliability of, 20: 18394
liver regeneration in, molecular mechanism for, 20: 18263
manganese-54 distribution in tissues of, after injection, 20: 18203(R) (LA-3432, pp 21-55)
radiation damage in, synergism between thermal and x, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on mitosis in bone marrow of, protective effects of sodium against x, 20: 18326
radiation effects on avoidance behavior of, x, 20: 18339
radiation effects on DNA and RNA metabolism in spleen cells of, x, 20: 18341
radiation effects on concentration of oxidized and reduced TPN in organs of, x, 20: 18343
radiation effects on food intake by, effects of chlorpromazine on x, 20: 18367
radiation effects on lipid metabolism in, x, 20: 18375
radiation effects on head of, pathological γ, 20: 18376
radiation effects on nervous system of, γ, 20: 18376
radiation effects on uptake of phosphorus-32 by, effects of cyclohexane and synkavite on, 20: 18379
radiation effects on adrenal glands in, 20: 18402
radiation effects on, protective effects of shielding against γ and proton, 20: 18441
radiation effects on, physiological, 20: 18188(R) (ORO-635)
radiation effects on deposition of injected fibrinogen in, x, 20: 18294(R) (TID-22766)
radiation effects on taste response of, x, 20: 18294(R) (TID-22766)
radiation effects on myelin synthesis in brain of, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiation effects on uptake of carbon-14-labeled orotic acid by liver RNA in, x, 20: 18263
radiation effects on hypoxia in, x, 20: 18272
radiation effects on catalase activation by DNA from liver of, 20: 18279
radiation effects on urinary glucuronide excretion by, x, 20: 18287 (EUR-2638.1)
radiation effects on central nervous system in, x, 20: 18292(R) (N-65-17068)
radiation effects on physiology of muscles from, 20: 18293 (NP-14898)
radiation effects on glycoprotein content in serum of, x, 20: 18258
radiation effects on DNAase activity in urine of, neutron, 20: 18262
radiation effects on thymocytes of, x, 20: 18455
radiation effects on leukocytes in, protective effects of B vitamins against beta, 20: 18499
radiation effects on erythropoiesis in, effects of erythropoietin on, 20: 18500
radiation effects on bone marrow of, effects of radiomimetic substances on, 20: 18534
radiation injuries of liver of, effects of cysteamine on x, 20: 18457
radiation injuries of, effects of AET on, 20: 18458
radioinduced glomerulosclerosis in kidneys of, x, 20: 18284 (AD-629512)
radioinduced leukopenia in, pathology of, 20: 18504
radioinduced mammary tumors in, effects of exposure fractionation and protraction on gamma, 20: 18319
radioinduced tumors in, effects of parabiosis on, 20: 18318
radioinduced tumors in, 20: 18188(R) (ORO-635)
radiosensitivity effects of cytotoxic and antimetabolite drugs on carcinomas in, 20: 18377
radiosensitivity effects of methandrostandiol in, 20: 18477
radiosensitivity of, effects of oil and wax suspensions of serotonin on, 20: 18487
radiosensitivity of, effects of injected DNA on, 20: 18495
radiosensitivity of, effects of lyophilized extracts of calf bone marrow or spleen on x, 20: 18497
radiosensitivity of transplanted mammary carcinomas in, effects of chemical compounds on, 20: 18533
radiosensitivity of, effects of pyridine diphosphate nucleotides on, 20: 18535
strontium-85 body burdens in, effects of sodium salicylates on, 20: 18276
strontium-90 uptake from milk by, effects of physico-chemical state on, 20: 18224
REACTION MECHANISMS
in exchange reactions, conference on, 20: 18635 (STI-PUB-107)
kinetic theory of hot-atom, 20: 20365
REACTOR CONTROL RODS
development of refractory, 20: 20183
drive mechanism for, design of, 20: 20193(P)
reactivity worth calculations for, Monte Carlo methods for, 20: 20196 (AEEW-M-581)
reactivity worths of cadmium–indium–silver, in water-moderated uranium oxide cores, 20: 20210 (WCAP-3269-39)
REACTOR CONTROL SYSTEMS
coolant pressure differential and loss rate from ruptures in EGCR primary, 20: 20251 (TID-22740)
development, 20: 20183
REACTOR COOLANTS
purification of organic, crystal structure and properties of Attapulgus clay for, 20: 18625 (EUR-2646.e)
sorption isotherms for, use of radioactive tracers for measuring dynamic and static, 20: 18626 (GA-6865)
vaporization of sodium, 20: 20201(R) (ANL-7110, pp 311-401)
REACTOR COOLING SYSTEMS
design of emergency, for high-temperature reactors, 20: 20191
development of liquid-metal, 20: 20237 (EURFNR-42F)
stress analysis of EGCR, 20: 20249 (TID-22738)
REACTOR ENGINEERING
research programs on, experimental and theoretical, 20: 20177(R) (BNL-929, pp 83-105)
REACTOR FUEL ALLOYS
development, 20: 20183
radioinduced swelling of, methods of inhibiting, 20: 20183
REACTOR FUEL ELEMENTS
boiling burnout in 19-rod bundles with subcooled water and fog, 20: 18860 (BNWL-206)
burnup measurements using semiconductor Compton spectrometer, 20: 19040 (SGAE-PH-33/1965)
cladding performance under coolant-loss conditions, stainless steel and Zircaloy, 20: 20221
cladding temperature in boiling-water reactors, 20: 20263 (TID-22758)
design for PWR, 20: 20223(P)
fabrication of high-temperature, methods for, 20: 20183
failure detection system in EBR-II, 20: 19018(R) (ANL-7110, pp 231-310)
gamma spectra from irradiated, performance of semiconductor spectrometer for measuring, 20: 19080
heat transfer burnout in clusters of, methods for detecting onset of, 20: 18859 (AEEW-R-432)
heat transfer failure mechanisms in organic-cooled, (E), 20: 20189
inspection of Rapsodie, equipment and procedures for, 20: 20273(T) (ORNL-tr-985)
processing by fluorination and hydrofluorination, 20: 18824(R) (EURAEC-1536)
radiation effects on boron-bearing, 20: 19253(R) (CEND-3107-261)
radiation effects on, research summary of, 20: 20183
stress distributions in, 20: 20201(R) (ANL-7110, pp 311-401)
thermal conductivity of contact between cladding and fissile material in, 20: 19238
REACTOR FUEL ELEMENTS (CERAMIC)
design of high power density, 20: 20224(P)
development and testing, 20: 20183
processing by fluid-bed fluoride volatility processes, computer program for use with, 20: 18820 (ANL-6992)
processing by fluid-bed fluoride volatility processes, 20: 18821 (ANL-7077)
REACTOR FUEL ELEMENTS (DISPERSION)
development of a uranium-bearing fiberglass, 20: 19178(R) (IDO-17154)
development of aluminum-matrix, 20: 19178(R) (IDO-17154)
radioinduced swelling in aluminum-matrix, neutron, 20: 19178(R) (IDO-17154)
REACTOR FUEL ELEMENTS (THERMOELECTRIC)
design, 20: 20286(P)
REACTOR FUEL PINS
neutron collision probabilities in clusters of, 20: 20203 (EUR-2751.e)
REACTOR FUEL RODS
brake for, design of hydraulic, 20: 20194(P)
fabrication of 5% enriched uranium carbide, safety criteria for, 20: 20220 (AI-Memo-8810(Rev.1))
thermal stress distribution in, radial, 20: 20201(R) (ANL-7110,

pp 311-401)
REACTOR FUELS
cycle cost calculations for power reactors, method of, 20: 20235 (EUR-2521.e)
cycle studies for fast power-breeder reactors, 20: 20229(R) (ANL-7110, pp 99-229)
development, 20: 19178(R) (IDO-17154)
diffusion of fission-product iodine from, 20: 20177(R) (BNL-929, pp 83-105)
dispersal of molten, heat conduction criteria for preventing, (T), 20: 20180(R) (STL-372-27, pp 22-35)
processing fast breeder, flowsheets for, 20: 20183
processing irradiated, design of extraction equipment for, 20: 18826 (UJV-1441)
processing molybdenum- and niobium-containing, oxidizing alkaline melt decomposition process for, 20: 18834
processing thorium and thorium aide, 20: 20183
radiation effects on coated-particle, 20: 20183
technology of, information center for, 20: 20220 (ORNL-TM-1358)
temperature distributions in, under transient conditions, (T), 20: 20190
testing of ceramic, design of devices of irradiation, 20: 19263
REACTOR MATERIALS
properties at high temperatures, 20: 20201(R) (ANL-7110, pp 311-401)
properties of, effects of sodium on, 20: 20183
thermal stability of, effects of lattice defects on, 20: 20365
REACTOR MATRICES
analysis of light water–thoria–urania, 20: 20183
cadmium ratios in, methods for measuring, 20: 20183
neutron absorption resonance integrals in cylindrical and slab geometry, 20: 20201(R) (ANL-7110, pp 311-401)
neutron buckling in heavy water-moderated, 20: 20183
neutron cadmium ratios in, dependence on moderating ratio, 20: 20200(R) (ANL-7110, pp 29-98)
neutron collision probabilities in pin clusters and rod lattices, 20: 20203 (EUR-2751.e)
neutron multiplication factors in water-moderated aluminum–plutonium and plutonium dioxide–uranium dioxide, 20: 20200(R) (ANL-7110, pp 29-98)
neutron physics of slightly enriched water-moderated uranium dioxide, 20: 20200(R) (ANL-7110, pp 29-98)
neutron spectra in plutonium dioxide–uranium dioxide, activation measurement of thermal, 20: 20200(R) (ANL-7110, pp 29-98)
photothermoelasticity of plates with central hole and other peripheral holes for, 20: 19237
REACTOR MODERATORS
neutron scattering by, computer program for thermal, 20: 19780 (JAERI-1094)
neutron scattering by, methods for calculating thermal, (T), 20: 19781 (JAERI-1095)
neutron thermalization in, review of integral, 20: 19779 (GA-8904)
REACTOR REFLECTORS
use in control of fast rocket reactors, 20: 20229(R) (ANL-7110, pp 99-229)
REACTOR SAFETY
accident analysis for EGCR, 20: 20257 (TID-22746)
coolant depressurization accident procedures for EGCR, 20: 20256 (TID-22745)
fuel meltdown studies in TREAT, for EBR-II, 20: 20229(R) (ANL-7110, pp 99-229)
radiation doses from maximum credible accident in Argonne Advanced Research Reactor, 20: 20200(R) (ANL-7110, pp 29-98)
research programs on, 20: 20183
REACTOR SAFETY EXPERIMENTS
experimental facilities of TREAT, instrumentation and operation of sodium-cooled loops of, 20: 19018(R) (ANL-7110, pp 231-310)
kinetic studies in SPERT, 20: 20183
meltdown studies in TREAT, 20: 20183
REACTOR SHIELDING
design of crushable, research on, 20: 20188(R) (IITRI-576P21-17)
neutron slowing down in, transfer matrices for, (T), 20: 19784 (NAA-SR-11530)
REACTOR SLURRIES
fission product bubble configuration in, 20: 20222
REACTOR TUBES
development for glow plug gaseous core reactors, 20: 20301 (NP-15906)
REACTORS
bearings for, in space applications, 20: 18891
containment of, research on, 20: 20188(R) (IITRI-576P21-17)
containment systems for, research on, 20: 20183
design of, nuclear data evaluation for, 20: 20218 (WAPD-T-1823)
fuel cycle calculations for, computer program for, 20: 20226 (AEEW-R-260)
fuel dispersal in, heat conduction criteria for preventing molten, (T), 20: 20180(R) (STL-372-27, pp 22-35)
fuel temperature distributions in operating, (T), 20: 20190
iodine-131 release at, human and milk contamination by, 20: 18983
kinetics and operational studies, 20: 20176(R) (ANL-7110)
neutron chains in reflected, spatial dependence of prompt, 20: 20201(R) (ANL-7110, pp 311-401)
neutron diffusion equations for, computer program for solving, 20: 20207 (ORNL-TM-1302)
neutron flux distribution in, method for measuring intracell, (E), 20: 20204 (INR-656/IX-A/R)
neutron flux measurement in, method for direct, 20: 20213
neutron flux monitoring in, using argon gas, 20: 20206 (NAA-SR-11356)
neutron kinetics in, computer program for, 20: 20202 (AWRE-O-4/66)
neutron slowing down in, transfer matrices for, (T), 20: 19784 (NAA-SR-11530)
neutron spectra in, computer program for thermal, 20: 20205 (JAERI-1097)
pressure vessel bottom plug for, design of, 20: 20192(P)
reactivity parameters of, determination using exponential piles, (E/T), 20: 20214
transfer functions for, method for synthesizing space-dependent, 20: 20201(R) (ANL-7110, pp 311-401)
REFRACTORY MATERIALS
development of metallic, for control rods, 20: 20183
properties at high temperature, bibliography on, 20: 19216 (NP-15388)
REGENERATION
effects of DNA, on DNA synthesis in HeLa cells, 20: 18267
mechanisms for rat liver, molecular, 20: 18263
radiation effects on Axolotl, x, 20: 18337
RELATIVITY THEORY
causality violation of rigid bodies in, uncertainty principle for, 20: 19700
energy conservation for particle collisions in, 20: 19275
Lorentz equations in special, electromagnetic theory from, 20: 19704
REMOTE-CONTROL EQUIPMENT
design for packaging radioactive wastes, 20: 20348 (RL-SA-60)
testing of auxiliary handling device at Rapsodie mockup, 20: 20273(T) (ORNL-tr-985)
REMOTE-VIEWING EQUIPMENT
design of camera stage for hot cells, 20: 19018(R) (ANL-7110, pp 231-310)
REPTILES
radiation effects on metabolism of lizards, chronic low-level, 20: 18211(R) (UCLA-12-576, pp 88-111)
RESEARCH REACTORS
cooling system for Juelich high-temperature, emergency, 20: 20191
design for materials testing at Casaccia, 20: 20327
design modification and operation of Democritus, problems in, 20: 20324
development and operation of, problems in, 20: 20317
development and operation at Cekmece Nuclear Research and Training Center, BNL cooperation in, 20: 20343
experimental facilities for RC-1, rotary specimen rack for, 20: 20313 (RT/ING-(65)18)
experimental facilities at Cekmece, Turkey, 20: 20318
experimental facilities, operation, and research programs of ARBI, 20: 20325
experimental facilities and instrumentation for, 20: 20328
experimental facilities and research programs at Boris Kidric Institute, 20: 20329
experimental facilities for neutron studies at Democritus, 20: 20336
experimental facilities at the Boris Kidric Institute, uses of, 20: 20319
operation and maintenance of Daphne, problems in, 20: 20323
operation of Ispra-1, Mar. 1959–Feb. 1963, 20: 20326
operation of TR-1, problems in, 20: 20321
operation of, safety rules and principles for, 20: 20322
radiation alarm system for Rossendorf, design of gamma, 20: 20316 (ZfK-RN-29)
radioisotope production in RA, 20: 20340
reactivity transfer functions of zero-power, space-dependent, 20: 19018(R) (ANL-7110, pp 231-310)
safety hazards of Japanese JPR-2, 20: 20358(R) (JAERI-5014)
use as thermal neutron sources, 20: 19796
use in agricultural research, 20: 20341
use in agronomical studies, 20: 20342
use in fission chemistry, 20: 20338
use in nuclear energy program, 20: 20330
uses of Italian RC-1, training and research, 20: 20333
uses of Italian RC-1, in solid state physics research, 20: 20335
uses of Italian RC-1, gamma-ray spectroscopy, 20: 20334
uses of, conference on, 20: 20314 (STI/DOC-56(Vol.1))
uses of, conference on, 20: 20315 (STI/DOC-56(Vol.2))
RESINS

radiation effects on sulfonic acid ion exchange, gaseous evolution in gamma, 20: 18728 (NIJS-R-458)
RESISTORS
performance of carbon, for temperature measurements at 3 to 80°K, 20: 19721 (CLM-R-47)
RESPIRATORY TRACTS
radioactivity in dog, detection of α and β, 20: 18235
RETICULO-ENDOTHELIAL SYSTEM
physiology of, in mice, 20: 18190(R) (UCRL-16613)
radiation effects on content of cells of, in peritoneal cavity of mice, x, 20: 18285 (AD-630103)
scanning of, use of technetium-99 in, 20: 18185(R) (BNL-929, pp 126-47)
RHENIUM
determination in platinum–rhenium alloys by bremsstrahlung activation methods, 20: 18614
diffusion in uranium carbide–zirconium carbide, 20: 19211(R) (N-65-21350)
diffusion in uranium carbide–zirconium carbide at 1800°C, 20: 19212(R) (N-65-21351)
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
neutron total cross section of, fast, 20: 19805(R) (ANL-7110, pp 1-28)
thermionic emission from lanthanum hexaboride-coated cathodes of, 20: 19229
RHENIUM ALLOY COUPLES
Re–W/W, radiation effects on in-pile thermocouples of, 20: 20185 (CONF-650204-9)
RHENIUM ALLOYS
Mo–Re, internal friction in deformed, 20: 19250
Os–Re, thermoelectric properties, 20: 20185 (CONF-650204-9)
Pt–Re, analysis for rhenium by bremsstrahlung activation methods, 20: 18614
Re–W, diffusion in uranium carbide–zirconium carbide, 20: 19211(R) (N-65-21350)
Re–W, diffusion in uranium carbide–zirconium carbide at 1800°C, 20: 19212(R) (N-65-21351)
Re–W, reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
RHENIUM ISOTOPES Re-182
nuclear data, 20: 19879
RHENIUM ISOTOPES Re-183
nuclear data, 20: 19880
RHENIUM ISOTOPES Re-184
nuclear data, 20: 19881
RHENIUM ISOTOPES Re-185
nuclear data, 20: 19882
RHENIUM ISOTOPES Re-186
decay scheme for, (E), 20: 19841 (UJV-1456/65)
RHENIUM ISOTOPES Re-187
energy level lifetimes of, (E), 20: 19931
RHODIUM
determination in platinum–rhodium alloys by bremsstrahlung activation analysis, 20: 18614
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
RHODIUM ALLOYS
Pt–Rh, analysis for rhodium by bremsstrahlung activation methods, 20: 18614
RHODIUM ISOTOPES Rh-103
neutron reactions (n,γ) and (n,n′) at 1 to 700 ev, spin of resonances in, (E), 20: 19866
RHODIUM ISOTOPES Rh-104
energy levels from rhodium-104 (n,γ) and (n,n′) reactions, spin of, (E), 20: 19866
RHODIUM ISOTOPES Rh-106
beta decay of, palladium-106 levels from, (E), 20: 19846
RIBONUCLEASE
radiolysis of, tracer studies of free radical distributions from gamma, 20: 18749
RIBONUCLEASE, DEOXY-
radiation effects on activity of, in rat urine, neutron, 20: 18262
RIBONUCLEIC ACID
properties of, incorporating carbon-14-labeled amino acids, 20: 18249
radiation effects on metabolism of, in rat spleen, x, 20: 18341
radiation effects on content of, in isolated carrot root cell, 20: 18395
radiation effects on biological functions of transfer, uv, 20: 18249
radiation effects on liver and intestinal synthesis of, tracer study in rats, 20: 18495
radiosensitivity effects of mammalian, on Salamander regeneration, x, 20: 18337
synthesis in mammalian cells in culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
synthesis in normal and tumorous cells, 20: 18264
synthesis in normal and tumorous cells, 20: 18266
synthesis in normal and tumorous cells, 20: 18267
synthesis in normal and tumorous cells, 20: 18265
synthesis of, enzyme reactions for, 20: 18205(R) (LA-3432, pp 178-262)
RIBONUCLEIC ACID, DESOXY-
content in X chromosome of Drosophila, 20: 18332
induction by Polyoma virus, in x-irradiation cells, 20: 18369
infection of *Escherichia coli* by bacteriophage, mechanism of, 20: 18204(R) (LA-3432, pp 130-77)
information transfer by, enzyme reactions involved in, 20: 18205(R) (LA-3432, pp 178-262)
properties of, chemical, biological, and physical, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on bacterial, K-reactivation of, 20: 18315
radiation effects on metabolism of, in rat spleen, x, 20: 18341
radiation effects on content of, in isolated carrot root cell, 20: 18395
radiation effects on, effects of purine deprivation on x, 20: 18256
radiation effects on content in guinea pig liver, effects of ploidy on x, 20: 18260
radiation effects on uptake of carbon-14-labeled orotic acid by rat liver, x, 20: 18263
radiation effects on synthesis of, x, 20: 18264
radiation effects on synthesis of, in embryonic mouse cells, x, 20: 18266
radiation effects on synthesis of, in mouse ascites tumor cells, x, 20: 18266
radiation effects on HeLa cell synthesis of, effects of DNA replication on, 20: 18267
radiation effects on, in *Micrococcus radiodurans*, 20: 18269
radiation effects on synthesis of, in normal and tumorous tissue, x, 20: 18271
radiation effects on synthesis of, time intervals for fractionated-dose, 20: 18278
radiation effects on activation of hepatic catalase by rat liver, 20: 18279
radiation effects on, in *Escherichia coli*, 20: 18313
radiation effects on synthesis of, in Ehrlich ascites carcinoma cells, x, 20: 18270
radiation effects on content in tumor cells, x, 20: 18460
radiation effects on liver and intestinal synthesis of, tracer study in rats, 20: 18495
radioinduced dissociation of histone from, 20: 18789
radioinduced free radicals in, y, 20: 18275
radioinduced linkage to benzopyrene, x, 20: 18788
radioinduced lymphosarcoma, lymphoma-induction in mice by, 20: 18339
radiosensitivity effects on lymphoma cells of 5-bromouracil-containing, x, 20: 18445
radiosensitivity effects in mice, 20: 18492
radiosensitivity effects of injected polymerized, in rats, 20: 18495
radiosensitivity of, in animal cells, 20: 18444
reactions with accelerated atomic hydrogen, 20: 18273
reactions with tritiated thymidine, 20: 18185(R) (BNL-929, pp 126-47)
replication in *E. coli*, tracer study of mechanisms for, 20: 18231
separation from bacteriophages, 20: 18190(R) (UCRL-16613)
synthesis in mammalian cells in culture, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
synthesis in normal and tumorous cells, 20: 18264
synthesis in normal and tumorous cells, 20: 18265
synthesis in normal and tumorous cells, 20: 18266
synthesis in normal and tumorous cells, 20: 18267
synthesis in *Stentor coeruleus*, cytoplasmic control of, 20: 18295(R) (UCLA-12-576, pp 27-56)
RIBONUCLEIC ACID, DESOXY- COMPLEXES
synthesis of, enzyme reactions for, 20: 18205(R) (LA-3432, pp 178-262)
RIBONUCLEIC ACID, SODIUM SALTS
radiosensitivity effects on pigments in mouse hair, x, 20: 18502
RIBONUCLEOTIDES, DESOXY-
synthesis of, chemical and enzymatic, 20: 18205(R) (LA-3432, pp 178-262)
RICE
radiation effects on seeds of, genetic y, 20: 18417
radioinduced mutations of, x, 20: 18414
radioinduced mutations in, use in plant breeding studies, 20: 18416
ROCKET MOTOR NOZZLES
propellant effects on tensile properties of, hydrogen, 20: 19228
ROCKET REACTORS
control of fast, using reflectors, 20: 20229(R) (ANL-7110, pp 99-229)
control of, methods development for automatic, 20: 20296(R) (N-65-21462)
design study of, using lithium hydride propellant, 20: 20201(R) (ANL-7110, pp 311-401)
fuel containment in coaxial jet-MHD-driven vortex, (T), 20: 20299 (NP-15903)
fuel containment in MHD-driven vortex of, (E), 20: 20300 (NP-15904)

research progress on fast, 20: 20229(R) (ANL-7110, pp 99-229)
safety of, research programs on, 20: 20183
ROCKET REACTORS (KIWI)
coolant fluctuations in Phoebus-1A, pressure-to-pressure transfer functions for, 20: 20295 (LA-DC-7514)
core design for, experiments on gaseous and solid, 20: 20304
gamma dose rates from TNT destruct, 20: 20294 (LA-3446)
reactivity of coupled, 20: 20183
ROCKS
age estimation and paleography of sedimentary, in New Jersey Triassic Basin, 20: 18924(R) (NYO-1669-11)
age estimation of igneous and meta-sedimentary, in western Conn. and New York, 20: 18924(R) (NYO-1669-11)
geology and mineralogy of, in western United States, 20: 18924(R) (NYO-1669-11)
iron/manganese distribution in marine environments, 20: 18895 (NYO-3450-1, pp 217-76)
radiation effects on proliferative capacity of carrot, 20: 18395
rare earth contents in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
strontium content in Triassic reef in Austrian Alps, theory of recrystallization mechanism from, 20: 18631 (NYO-2266-1)
ROCKY FLATS PLANT, DENVER
environs monitoring, 1965, 20: 18918
RODENTS
radiation effects on ecology of Nevada Test Site, 20: 18211(R) (UCLA-12-576, pp 88-111)
RODS
heat transfer in parallel arrays of, with turbulent air flow, 20: 18876
ROOTS
growth of Phaseolus, effects of rare earths on, 20: 18237
use of *Vicia faba*, as test system for radioprotective compounds, 20: 18485
ROSE BENGAL
separation of iodine-labeled, from nonbound iodine, 20: 18815
RUBIDIUM
electron reactions with, energy losses in, (E), 20: 19393
heat transfer from boiling, 20: 20183
ion exchange properties on zirconyl oxalates, 20: 18840
ion exchange reactions with hydrogen on ferrocyanide molybdate, kinetics of, 20: 18564 (EUR-2748.e)
separation from cesium by ion exchange, 20: 18811
RUBIDIUM IODIDES
iodine-129 gamma emission in crystals of, Debye-Waller factor and second order Doppler shift for, (T), 20: 20150
RUBIDIUM ISOTOPES
isotopic mixing constants of, volume, (T), 20: 19970
RUBIDIUM ISOTOPES Rb-83
decay scheme, 20: 18556(R) (BNL-929, pp 66-82)
RUBIDIUM ISOTOPES Rb-86
beta decay, (E), 20: 19828 (N-65-22126)
beta decay of, circularly polarized β-γ correlation in ($2^- \rightarrow 2^+$), (E), 20: 19858
beta spectra of, $2^- \rightarrow 2^+$ and $2^- \rightarrow 0^+$, (E), 20: 19860
diffusion in soil, effects of compaction on, 20: 18816
preparation by irradiation of rubidium chloride, 20: 18811
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
RUBIDIUM SULFATES
radiolysis of deaerated aqueous solutions of, cation polarization and hydrogen peroxide formation in gamma, 20: 18782
RUBIES
radiation effects on properties of, for use as laser, 20: 20110 (NASA-TN-D-3379)
RUSSIAN REACTORS
design and testing of thermionic power, 20: 20277
RUTHENIUM, BISCYCLOPENTADIENYL-
radiolysis of, reactions of recoil ruthenium atoms from neutron, 20: 18556(R) (BNL-929, pp 66-82)
RUTHENIUM CHLORIDES
sorption of ruthenium-106-labeled colloids of, on manganese dioxide, 20: 18847
RUTHENIUM ISOTOPES
isotopic mixing constants of, volume, (T), 20: 19970
preparation of foil targets of, 20: 19297 (IAE-973)
RUTHENIUM ISOTOPES Ru-99
energy level transitions of, M1–E2 interference in 90-kev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
energy levels of, half life of 90-kev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
RUTHENIUM ISOTOPES Ru-103
distribution in sea water in Swordfish Program, 20: 18576(R) (TID-22660)
RUTHENIUM ISOTOPES Ru-105
dosimetry of, equation for internal, 20: 18955
RUTHENIUM ISOTOPES Ru-106
content in organisms and water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
content in Pacific Ocean sediments near mouth of Columbia River, 20: 18902 (RLO-1725-41)

S

SAFETY
bibliography on nuclear, 20: 18945 (ORNL-NSIC-14)
of nuclear auxiliary power systems for space, 20: 18949 (SC-DC-66-1369)
plutonium materials management at Rocky Flats, Colo., 20: 18948 (RFP-720)
regulations for shipping radioactive materials, 20: 18940 (EUR-2747.f)
SALAMANDERS
radiation effects on regeneration in Axolotl, x, 20: 18337
SALIVARY GLANDS
radiosensitivity of, 20: 18523
SALT DEPOSITS
radiation and temperature effects on mine stability and plastic flow in, 20: 18897 (ORNL-P-2006)
waste disposal in, design and operation of Project Salt Vault for, 20: 20347 (ORNL-P-2058)
SALTS
distribution in Pacific Ocean near mouth of Columbia River, 20: 18902 (RLO-1725-41)
SAMARIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
SAMARIUM ALLOYS
Ge–Sm, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Sm, preparation and crystal structure of SmGe, 20: 19224
SAMARIUM CHLORIDES
magnetic phases, (T), 20: 20143
SAMARIUM ISOTOPES Sm-148
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
SAMARIUM ISOTOPES Sm-150
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
SAMARIUM ISOTOPES Sm-152
energy levels of, high-spin rotational, (E/T), 20: 19953
SAMARIUM ISOTOPES Sm-153
determination by autoradiographic measurement of half life using ring oven methods, 20: 18584
SAMARIUM SILICIDES
preparation and crystal structure of, 20: 19224
SAMPLING
equipment for multi-coil magnetic probe signals, design of, 20: 19998 (CLM-R-50)
SANDSTONE
rock matrix effect in, theory of neutron logging for, 20: 18932
SAP (SINTERED ALUMINUM PRODUCTS)
creep properties, 20: 19220 (RT/MET-(65)2)
fabrication of cylinders of, using magnetic fields, 20: 19199 (RT/EL-(65)9)
mechanical properties of APM-M768, effects of temperature on, 20: 19178(R) (IDO-17154)
microstructure of, effects of alumina content and cold-working on, 20: 19220 (RT/MET-(65)2)
performance of APM-M768, in-pile, 20: 19178(R) (IDO-17154)
tensile properties at −196 to 25°C, 20: 19204 (EUR-2648.i)
SARCOMAS
radiation effects on incidence and latency of mouse lympho-, x, 20: 18317
radiation effects on DNA synthesis in, x, 20: 18271
radioinduced mouse lympho-, etiology of x, 20: 18359
radiotherapy of mediastinum, late pathological effects, 20: 18519
SATELLITES
disposal of orbiting SNAP, techniques for ocean burial, 20: 20302 (SC-RR-65-472)
re-entry and impact of polar orbit, probability distributions of latitudes of, (T), 20: 20361 (SC-RR-66-41)
SAVANNAH RIVER AREA (S. C.)
environs monitoring, 1964, 20: 18915
SAXTON POWER REACTOR
reactivity of, zero-power, (E/T), 20: 20271(R) (WCAP-3385-6)
SCANDIUM
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110,

pp 1-28)
separation from aqueous solutions by ion exchange, tracer studies of, 20: 18831
separation from perchlorate–chloride and perchlorate–nitrate solutions, 20: 18832
SCANDIUM COMPLEXES
chloride and nitrate, formation and stability of, 20: 18831
SCANDIUM ISOTOPES Sc-43
beta decay of, log ft values for, (T), 20: 19932
SCANDIUM ISOTOPES Sc-44
beta decay of, log ft values for, (T), 20: 19932
nuclear magnetic dipole moments for, (T), 20: 19932
production method for, 20: 20177(R) (BNL-929, pp 83-105)
SCANDIUM ISOTOPES Sc-45
nuclear magnetic dipole moments for, (T), 20: 19932
SCANDIUM ISOTOPES Sc-46
beta decay of, log ft values for, (T), 20: 19932
nuclear magnetic dipole moments for, (T), 20: 19932
SCANDIUM ISOTOPES Sc-47
beta decay of, log ft values for, (T), 20: 19932
nuclear magnetic dipole moments for, (T), 20: 19932
SCANDIUM ISOTOPES Sc-48
energy levels, (E), 20: 19273(R) (BNL-929, pp 3-43)
SCANDIUM ISOTOPES Sc-49
beta decay of, log ft values for, (T), 20: 19932
SCANDIUM OXIDES
$ScO_{1.5}$–ZrO_2, electric conductivity of, 20: 19243
SCATTERING
amplitude of, generalized Regge representation of, 20: 19588
amplitudes for, analyticity and unitarity of, (T), 20: 19595
amplitudes for, analyticity of, (T), 20: 19605
amplitudes in complex angular momentum plane, analyticity test for, 20: 19567
amplitudes of nonrelativistic two-particle, integral representation for, 20: 19549
angular moments in, Born series for Jost function for large complex, 20: 19565
angular momentum in, complex, (T), 20: 19596
experiments on Compton, using low-activity sources, 20: 19049
Feynman graphs for, discontinuities of, (T), 20: 19582
model for high-energy, multiperipheral, (T), 20: 19598
N/D method in, inelasticity in one-channel, 20: 19566
potential, amplitudes in, 20: 19551
potential, asymptotic expansion for Green function of nonrelativistic, (T), 20: 19565
potentials in, high-energy approximation for nonlocal, 20: 19573
potentials in, quasi-Born treatment of square-well, 20: 19559
Regge-pole theory of high-energy, 20: 19597
S-matrix for, experimental test of substitution law in, 20: 19516
S-matrix for, implications of isospin I^2 and I_3 conservation for, 20: 19575
S-matrix theory, 20: 19594
S-matrix theory, 20: 19606
S-matrix theory for, substitution law in, 20: 19586
S-matrix theory of, relativistic, 20: 19593
theory of high-energy, review on, 20: 19609
theory of multichannel, determinantal formulation of, 20: 19599
theory of, research summary on, 20: 19169(R) (BNL-929, pp 106-11)
transport and multiplicative processes in, theory of first-passage distributions in, 20: 20101
SCHISTOSOMA
radiation effects on reactions in mice, gamma, 20: 20360(R) (PRNC-73)
SCINTILLATION DETECTORS
beta counting in, from carbon-14 decay, balanced quenching method for, 20: 18594
collimators for, used in radiodiagnosis, 20: 19051
design and performance of scintillation camera, 20: 19085
design and performance of, for measuring thermal neutrons in soil–water systems, 20: 19092
design for low-energy γ and x radiations, 20: 19089
design for neutron capture studies, 20: 19035 (NIJS-R-470)
efficiency and resolution of thin crystal, for actinides, 20: 18562(R) (EUR-2640.e)
efficiency of plastic, for x-ray flux at 1.8 to 4.5, 20: 19066
performance for neutron spectroscopy, 20: 19790
performance of well-type sodium iodide-crystal, for gamma detection, 20: 19090
performance of, error statistics for, 20: 19053
performance of, error-statistics calculations for, 20: 19054
pulses from, photo-peak analysis program for, 20: 19014 (AD-616703)
quenching of, reduction of oxygen, 20: 18712
use of liquid, for measuring carbon-14-labeled carbon dioxide, 20: 18999
use of plastic, in thyroid carcinoma therapy, 20: 19084
SCOTLAND
strontium-90 content in human bones in, 20: 18922
SCREENS
use of kryptonated molecular, for determining water in organic liquids, 20: 18570(R) (NYO-2757-5)
SEA WATER
age of, tracer study, 20: 18934
analysis for cesium-137 and strontium-90, radiometric, 20: 18592
analysis for copper, manganese, and copper, activation, 20: 18576(R) (TID-22660)
carbon-14 separation from, 20: 18934
chemical reactions in, 20: 18633 (NYO-3450-1, pp 203-11)
content of trace elements in, effects of removal, supply, and transport mechanisms on, 20: 18892 (NYO-3450-1, pp 41-89)
desalination of, environmental factors for nuclear, 20: 20288 (BNWL-SA-596)
desalination of, evaluation of potential energy sources for, 20: 18704
desalination of, objectives of United Kingdom program for, 20: 18705
desalination of, steam cycles for, 20: 20291
desalination using nuclear power plants, economics of, 20: 20292
deuterium distribution in, factors affecting, 20: 18201 (NYO-3450-1, pp 149-68)
dispersion and movement in Cape Kennedy area, physical processes of, 20: 20359 (NYO-2973-1)
iron/manganese distribution in environments of, 20: 18895 (NYO-3450-1, pp 217-76)
isotopic variations of deuterium and oxygen-18 in, 20: 18896 (NYO-3450-1, pp 277-374)
mixing of deep ocean, tracer study, 20: 18934
movement and mixing of, research on, 20: 18198
radioactivity from gamma emitters in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
radioactivity from trace elements in, Swordfish Program studies on, 20: 18576(R) (TID-22660)
separation of radioisotopes from, methods for, 20: 18576(R) (TID-22660)
solvent properties for gases, effects of physicochemical factors on measurements of, 20: 18632 (NYO-3450-1, pp 91-107)
sorption of manganese-54 and zinc-65 from, by montmorillonite clay, 20: 18576(R) (TID-22660)
strontium content in, estimation of, from content in aragonite oolites, 20: 18631 (NYO-2266-1)
sulfur isotopic contents in, biogeochemical studies on, 20: 18893 (NYO-3450-1, pp 131-48)
SEALS AND GLANDS
development for EGCR loading machine actuating cylinders, 20: 20244 (ORNL-TM-1419)
development for potassium-driven turbines for space power plants, 20: 18881(R) (N-65-18742)
SEDIMENTATION
radiation effects on rate of bismuth chloride, 20: 18792
SEED
radiation effects combined with magnetic fields on barley, x, 20: 18387
radiation effects on barley, effects of seed water on oxygen effect on gamma, 20: 18389
radiation effects on rice, genetic γ, 20: 18416
radiation effects on rice, genetic γ, 20: 18417
radiation effects on barley, genetic x, 20: 18418
radiation effects on bean and soybean, genetic x, 20: 18419
radiation effects on barley, protective effects of carbonates and phosphates against x, 20: 18435
radioinduced mutations in barley, x, 20: 18411
radiosensitivity of *Lolium perenne*, effects of water content on, 20: 18382
radiosensitivity of rice, x, 20: 18414
strontium-90 content in plant, 20: 18906(T)
SEEDLINGS
radiation effects on lipid metabolism in cotton, γ, 20: 18374
radiation effects combined with magnetic fields on barley, x, 20: 18387
radiation effects combined with magnetic fields on development of, x, 20: 18388
radiation effects on barley, x, 20: 18411
SEIGNETTOELECTRIC MATERIALS
conference on ferroelectricity, 20: 20171
SEISMIC WAVES
interactions of, Feynman diagrams and rules for, 20: 18936
SEISMOLOGY
use of nuclear explosions in, bibliography on, 20: 18855 (CEA-Bib-66)
SELENATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
SELENITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

SELENIUM
distribution in sea water, effects of depth on, 20: 18892 (NYO-3450-1, pp 41-89)
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
radiosensitivity effects on catalase, 20: 18449

SELENIUM ISOTOPES Se-75
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
dosimetry of, at various source distances, 20: 19091
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583

SELENIUM ISOTOPES Se-76
isotope effects in reduction of sodium selenates and selenites, 20: 18642

SELENIUM ISOTOPES Se-82
isotope effects in reduction of sodium selenates and selenites, 20: 18642

SEMICONDUCTOR DETECTORS
development, 20: 18198
development, 20: 18988(R) (ORNL-929, pp 58-66)
development for fast neutrons, for SNAP 10A, 20: 20298 (NAA-SR-11762)
development of telescope, 20: 19813 (IKF-14)
fabrication and performance of large-volume lithium-drifted germanium, for gamma radiation, 20: 19072
fabrication of lithium-drifted surface-barrier silicon, 20: 19079
fabrication of p-n junction, using ion implantation technique, 20: 20125
fabrication of thin-window germanium, method for, 20: 19043 (UCRL-16480)
fabrication, testing, properties, and uses of silicon surface-barrier, 20: 19078
performance as gamma spectrometers for scanning irradiated fuel elements, 20: 19080
performance for dosimetry of α and proton beams, 20: 18190(R) (UCRL-16613)
performance for measurement of alpha range-energy relation in air, 20: 19069
performance of lithium-drifted germanium p-i-n, for gamma spectrometry, 20: 19061
performance of lithium-drifted surface-barrier silicon, for conversion electrons, 20: 19079
performance of lithium-drifted germanium, for high-resolution gamma spectrometry, 20: 19087
performance of lithium-drifted germanium, for short-lived radioisotopes, (E), 20: 19273(R) (BNL-929, pp 3-43)
performance of silicon, for energy measurements on fission fragments, 20: 19070
resolution of germanium and silicon, (T), 20: 19063
use in proton-recoil neutron spectrometer, 20: 19018(R) (ANL-7110, pp 231-310)
use of lithium-drifted silicon, in dosimetry, 20: 19031(R) (N-65-19766)
use of silicon, for wide-range gamma dosimetry, 20: 19015 (AD-629511)

SEMICONDUCTORS
crystal structure of, analysis using inelastic scattering of thermal neutrons, 20: 20170
doping of, by rare-earth ion bombardment, 20: 20122
effects on gamma radiolysis of methanol, catalytic, 20: 18744
fabrication of p-n junction, using ion implantation technique, 20: 20125
magnetic field effects on Pippard, gauge-invariant nonlocal theory for, 20: 19740
performance of diode, as photomultiplier element, 20: 19042 (UCRL-14445)
preparation of radiation-resistant thin-film diodes, 20: 19096(R) (N-65-17884)
radiation effects on, 20: 20365
radiation effects on, gamma and neutron, 20: 19098(R) (N-65-17953)

SHEEP
fission product metabolism in, 20: 18188(R) (ORO-635)
radiation effects on, pathological γ and neutron, 20: 18188(R) (ORO-635)
radiation effects, 20: 18198

SHELLS
thermal loading of cylindrical, dynamic response of, (T), 20: 18852 (SCL-DR-65-144)

SHELTERS
furnishings design for, 20: 18946 (ORNL-TM-1428)
shielding parameters of, after nuclear attack, 20: 18938 (AD-629784)

SHIELDING
bibliography on accelerator and space vehicle, 20: 20098 (ORNL-RSIC-12(Vol.1))
design for manned space vehicles using nuclear rocket propulsion, 20: 20093 (N-65-22849)
effects of abdominal, on survival in γ- and proton-irradiated rats, 20: 18441
effects of intestinal, on hematopoiesis in mice, 20: 18432
gamma buildup factors for, empirical functions for, 20: 20097 (ORNL-RSIC-10)
gamma buildup factors for, empirical functions for, 20: 20097 (ORNL-RSIC-10)
gamma dose rate behind laminated slabs, computer program for, 20: 20095 (ORNL-3805)
gamma transport in, exponential transform for, 20: 20099 (ORNL-RSIC-14)
neutron transport in, exponential transform for, 20: 20099 (ORNL-RSIC-14)

SHIPPING
methods for plutonium, at Rocky Flats, Colo., 20: 18948 (RFP-720)
regulations for radioactive materials, 20: 18940 (EUR-2747.f)

SHIPPINGPORT ATOMIC POWER STATION, PENNA.
environs monitoring, 1964, 20: 18915

SHIPPINGPORT PRESSURIZED WATER REACTOR
fuel blanket assembly for core-2, design of MELBA, 20: 20270 (WAPD-TM-483)

SHOCK TUBES
plasma-stream and shock production and propagation in discharge, (E), 20: 20089

SHOCK WAVES
equations for, in classical and relativistic MHD, 20: 19627
production and propagation in discharge tubes, (E), 20: 20089
propagation in helium and neon afterglow plasmas, Tonks-Dattner resonance determination of axial, (E), 20: 20044
propagation in relativistic magnetohydrodynamics, (T), 20: 19623
propagation of precursor, from TNT detonation at ground level, 20: 18923 (N-65-22654)
stability and structure in interplanetary space, (T), 20: 19326 (N-65-23194)
stability in MGD flow past wedge, (T), 20: 19631

SILANE
alkyl, yields in radiolysis of liquid tetramethylsilane, 20: 18729(R) (NYO-2007-9)
germyl- and methyl-, yields in mercury sensitized photolysis of germane and silane systems, 20: 18729(R) (NYO-2007-9)
tetramethyl-, radiolysis of liquid, mechanisms and yields in, 20: 18729(R) (NYO-2007-9)
GeH_4–SiH_4, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)
methyl iodide–SiH_4, preparation of volatile hydrides by mercury sensitized photolysis of, 20: 18729(R) (NYO-2007-9)

SILICATES
production in contrasting gaseous spheres, (T), 20: 19345
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

SILICIDES
reactions of refractories coated with, with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)

SILICON
analysis for boron by deuteron or proton activation, 20: 18582
boron-ion reactions at 10 to 80 kev, production of electric junctions by, (E), 20: 20123
cesium-ion reactions at 1 to 20 kev, channeling effects and penetration in, 20: 20124
determination in boron, activation, 20: 18568(R) (NBL-230)
determination in uranium by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
fabrication of lithium-drifted surface-barrier detectors of, 20: 19079
fabrication of lithium-doped diodes of, 20: 19106(R) (N-65-19886)
fabrication, testing, properties, and uses of surface-barrier detectors of, 20: 19078
ionization equilibria in sun, (T), 20: 19338
performance in semiconductor detectors, (T), 20: 19063
performance of detectors of, for energy measurements on californium-252 fission fragments, 20: 19070
phosphorus-ion reactions at 10 to 80 kev, production of electric junctions by, (E), 20: 20123
potassium-ion reactions at 1 to 20 kev, channeling effects and penetration in, 20: 20124
properties of rare earth doped, electric and optical, 20: 20122
radiation damage in solar cells of, proton, 20: 19095 (N-65-16347)
radiation damage in, effects of impurities on electron, 20: 19102(R) (N-65-19693)
radiation damage in, energy dependence of electron, 20: 19105 (N-65-19870)
radiation effects on single-crystal, alpha and beta, (E/T), 20: 19273(E)* (BNL-929, pp 3-43)
radiation effects on, effects of impurities on, 20: 19106(R) (N-65-19886)
radiation effects on photovoltaic parameters of solar cells of, proton, 20: 19106(R) (N-65-19886)

radiation effects on electric properties of MOS structures of, 20: 19113
radioinduced damage in solar cells of p-type, temperature dependence of electron, 20: 19115
radioinduced defects in, interaction between lithium and electron, 20: 19102(R) (N-65-19693)
radioinduced defects in, types of, 20: 19104(R) (N-64-19867)
radioinduced defect in, energy dependence and properties of electron, 20: 19106(R) (N-65-19886)
radioinduced defects in phosphorus-doped, electron, 20: 19108(R) (N-65-21459)
radioinduced defects in, introduction rate of electron, 20: 19110(R) (N-65-21762)
radioinduced defects in solar cells of p-type, annealing of electron, 20: 19114
use of semiconductors of, for wide-range gamma dosimetry, 20: 19015 (AD-629511)
x-ray absorption spectra of K shell in gaseous silicon chlorides, (E), 20: 19389

SILICON CHLORIDES
silicon K-absorption spectrum in gaseous, (E), 20: 19389

SILICON ISOTOPES
separation and preparation of targets at ORNL calutron, 20: 19153

SILICON ISOTOPES Si-26
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))

SILICON ISOTOPES Si-28
deuteron reactions (d,n) at 7.0 to 10.0 Mev, (E), 20: 19805(R) (ANL-7110, pp 1-28)
deuteron reactions (d,p), silicon-29 levels from, (E), 20: 19846
neutron reactions (n,p) at 9.1 to 21 Mev, angular distributions from, (E/T), 20: 19813 (IKF-14)
neutron reactions (n,γ), silicon-29 levels from, (E), 20: 19846
production in alpha reactions (α,t) with aluminum-27 at 28.6 Mev, level population in, (E), 20: 19876

SILICON ISOTOPES Si-29
energy levels of, g-factor and lifetime of, (E), 20: 19846
production in alpha reactions (α,d) with aluminum-27 at 28.6 Mev, level population in, (E), 20: 19876

SILICON ISOTOPES Si-30
deuteron reactions (d,α) at 6.5 and 6.7 Mev, angular distributions from, (E), 20: 19971

SILICON OXIDES
effects on gamma radiolysis of methanol, catalytic, 20: 18744
performance as gaseous core reactor tube, 20: 20301 (NP-15906)
radiation effects on gels of, x-ray scattering studies on fast-neutron, 20: 19254 (CONF-650629-3)
use of kryptonated, for determining water in organic liquids, 20: 18570(R) (NYO-2757-5)
Al_2O_3–SiO_2, effects of irradiated, on reactions of isopropylbenzene, 20: 18768
Al_2O_3–SiO_2, uses as catalyst in conversion of acetylene to benzene, 20: 18933

SILICON SYSTEMS
Al–Mg–Si, fabrication of cylinders of Anticorodal, using magnetic fields, 20: 19199 (RT/EL-(65)9)
Al–Sn–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)

SILICONES
silicone–TiO_2, radiation effects on, kryptonate method for determining uv, 20: 18570(R) (NYO-2757-5)

SILTS
age estimation and paleography of, in New Jersey Triassic Basin, 20: 18924(R) (NYO-1669-11)
age estimation of, from protactinium-231 deposition rates, 20: 18926 (NYO-3450-1, pp 29-40)
content of trace elements in ocean, effects of removal, supply, and transport mechanisms on, 20: 18892 (NYO-3450-1, pp 41-89)
geochemistry of deep-sea, trace element studies on, 20: 18892 (NYO-3450-1, pp 41-89)
iron/manganese distribution in marine, 20: 18895 (NYO-3450-1, pp 217-76)
lead isotopic composition in, from Baltic and Canadian Shield regions, 20: 18894 (NYO-3450-1, pp 169-84)

SILVER
distribution in sea water, effects of depth on, 20: 18892 (NYO-3450-1, pp 41-89)
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
neutron elastic and inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
oxygen-18 exchange reactions on films of, kinetics of, 20: 18808
photoactivation of natural, excitation levels in nuclear, (E), 20: 19865
sorptive properties for oxygen, kinetics of, 20: 18808
superconducting energy gap of films of, proximity effects of lead films on induced, 20: 19754

SILVER ALLOYS
Ag–rare earth, preparation from amalgams by heating, 20: 19185
Cd–In–Ag, reactivity worths in water-moderated uranium oxide cores, 20: 20210 (WCAP-3269-39)
Mg–Ag, lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363

SILVER CHLORIDES
defects in, production and properties of point, 20: 20365
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

SILVER IODIDES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

SILVER ISOTOPES Ag-107
photoactivation of, excitation levels in, (E), 20: 19865

SILVER ISOTOPES Ag-109
photoactivation of, excitation levels in, (E), 20: 19865

SILVER NITRATES
sorption by glass surfaces, 20: 18846

SILVER VANADATES
preparation of kryptonates of, by diffusion, 20: 18570(R) (NYO-2757-5)

SKELETON
aging, growth, and repair of, autoradiographic studies on, 20: 18185(R) (BNL-929, pp 126-47)
plutonium-239 content in lobster, 20: 18227
tracer studies of, properties of plutonium-237 for, 20: 18221

SKIN
analysis of rattlesnake, neutron activation, 20: 18618
photosensitivity of, effects of furocoumarins on, 20: 18466
radiation dose to, methods for measuring radiographically induced, 20: 18505
radiation effects on rabbit, sieve-controlled x, 20: 18357
radiation effects on swine, ionizing, 20: 18185(R) (BNL-929, pp 126-47)
radiation effects on, following radium therapy of cervical cancer combined with telecobalt or x rays, 20: 18309
radiosensitivity of, effects of temperature on, 20: 18454
radiosensitivity of, neutron and x, 20: 18548
radiotherapy of tumors of, β, 20: 18528
use of guinea pig, as test system for radioprotective compounds, 20: 18485

SMOKES
polonium-210 in cigarette, 20: 18965

SNOW
lead content in Greenland, role of industrial lead pollutants in, 20: 18944 (NYO-3450-1, pp 213-15)

SODIUM
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
content in Phaseolus, effects of rare earths on, 20: 18237
determination in quartz crystals from Providencia area, Zacatecas, Mexico, activation, 20: 18631 (NYO-2266-1)
effects on reactor materials at high temperatures, 20: 20183
electron reactions with, ionization cross sections for, (T), 20: 19400
Fermi surface of, from positron annihilation data, (E), 20: 20169
ion exchange properties on zirconyl oxalates, 20: 18840
neutron elastic and inelastic scattering by, fast, 20: 19805(R) (ANL-7110, pp 1-28)
neutron scattering by liquid, review on, (E), 20: 19799
neutron total cross section of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
positron annihilation in, temperature effects in, (E/T), 20: 20167
proton reactions with, ionization cross sections for, (T), 20: 19400
radiation effects on content in muscle, γ and x, 20: 18293 (NP-14898)
radiosensitivity effects on mitosis in rat bone marrow cells, x, 20: 18326
transport in hamster intestine, effects of heavy water and water on active and passive, 20: 18212
vaporization in reactor coolant channels, 20: 20201(R) (ANL-7110, pp 311-401)

SODIUM ALLOYS
Pb–Na, preparation of kryptonates of, by diffusion, 20: 18570(R) (NYO-2757-5)

SODIUM CARBONATES
Na_2CO_3–$NaNO_3$, use for processing molybdenum- and niobium-containing irradiated fuels by oxidation, 20: 18834

SODIUM CHLORATES
radiation effects on, 20: 20365
radiation effects on chlorine-35 NQR in, gamma and x, 20: 20118

SODIUM CHLORIDES
effects on iodine-131 excretion by calves, 20: 18223
radioinduced N centers in, symmetry of, 20: 20159
B_2O_3–NaCl, radioinduced defects in, ESR spectra of gamma,

20: 19256(R) (NYO-2024-9)
KCl–NaCl, reactions of ammonia with uranium tetrachloride in molten, precipitation of uranium nitrides by, 20: 18698
SODIUM DECYL SULFATES
micelle formation and hydrophobic bonding of, in heavy water, 20: 18687
SODIUM DODECYL SULFATES
micelle formation and hydrophobic bonding of, in heavy water, 20: 18687
SODIUM FLUORIDES
radioinduced color centers in, at 80 and 200°K, 20: 20106 (COO-1044-23)
sorptive properties for uranium hexafluoride, 20: 18824(R) (EURAEC-1536)
SODIUM HYDROXIDES
effects on radioinduced oxidation of cumene, 20: 18727 (JAERI-1100)
NaOH–$NaNO_3$, use for processing molybdenum- and niobium-containing irradiated fuels by oxidation, 20: 18834
SODIUM IODATES
tellurium-125 Mössbauer effect in, (E), 20: 20148
SODIUM IODIDES
efficiency and resolution of thin crystal, in scintillation detector, 20: 18562(R) (EUR-2640.e)
gamma energy absorption at 122 kev to 2.62 Mev in thallium-activated, peak-total ratios for, 20: 19075
gamma photofractions for well-type scintillation crystals of, 20: 19076
iodine-129 gamma emission in crystals of, Debye-Waller factor and second order Doppler shift for, (T), 20: 20150
performance of crystal scintillation counters of, for gamma detection, 20: 19090
B_2O_3, radioinduced defects in, ESR spectra of gamma, 20: 19256(R) (NYO-2024-9)
SODIUM IONS
effects on carbon dioxide radical ESR, 20: 20161
exchange with barium on zeolite, thermodynamics of, 20: 18629(R) (NP-15353)
SODIUM ISOTOPES Na-20
mass of, determination from Q values, (T), 20: 19273(R) (BNL-929, pp 3-43)
SODIUM ISOTOPES Na-22
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
content in rain water at Livourne, Italy, 20: 18907
decay of, branching ratios for electron-capture, (E), 20: 19831 (NP-15912)
transport in hamster intestine, effects of heavy water and water on active and passive, 20: 18212
SODIUM ISOTOPES Na-23
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
SODIUM ISOTOPES Na-24
beta decay of, Fermi matrix element for, (T), 20: 19898
dosimetry of, equation for internal, 20: 18955
hyperfine structure and magnetic moments of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
production of isomeric, in neutron activation of aluminum and magnesium at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
yields from high-energy proton reactions, 20: 18556(R) (BNL-929, pp 66-82)
SODIUM NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
use for processing irradiated fuels containing molybdenum and niobium by oxidation, 20: 18834
Na_2CO_3–$NaNO_3$, use for processing molybdenum- and niobium-containing irradiated fuels by oxidation, 20: 18834
NaOH–$NaNO_3$, use for processing molybdenum- and niobium-containing irradiated fuels by oxidation, 20: 18834
SODIUM OXIDES
corrosive effects on aluminum alloys, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
SODIUM PERIODATES
iodine-127 and -129 Mössbauer isomer shifts in, (E), 20: 20139
SODIUM PROTACTINIUM FLUORIDES
preparation and properties of, 20: 18681
SODIUM SALICYLATES
effects on strontium-85 body burdens in mice and rats, 20: 18229
SODIUM SELENATES
reduction of, effects of selenium-76 and selenium-82 in, 20: 18642
SODIUM SELENITES
reduction of, effects of selenium-76 and selenium-82 in, 20: 18642
SODIUM SPACE
effects of AET on, in rats, 20: 18458
SODIUM SULFATES
radiolysis of deaerated aqueous solutions of, cation polarization and hydrogen peroxide formation in gamma, 20: 18782
SODIUM TELLURATES
tellurium-125 Mössbauer effect in, (E), 20: 20148
SODIUM THIOSULFATES
radiosensitivity effects on blood vessels in rabbit heart, x, 20: 18456
SODIUM TUNGSTATES
uses in determination of rare earths, 20: 18608
SOILS
calcium content of, effects on radiostrontium uptake by plants, 20: 18303
cesium uptake by plants from, effects of chemical composition on, 20: 18208(R) (TID-22715)
compaction of, effects on rubidium-86 and strontium-89 diffusion, 20: 18816
diffusion coefficients in loam, effects of compaction on rubidium-86 and strontium-89, 20: 18816
fission product transport in, tracer study, 20: 18188(R) (ORO-635)
fission product transport in, effects of chelating agents on, 20: 18211(R) (UCLA-12-576, pp 88-111)
interfaces with water, scintillation detector for locating, 20: 19092
moisture determination in, by neutron energy losses, effects of chlorine, iron, and potassium on, 20: 19118
radioactivity in, 1963 to 1965, 20: 18980
radioactivity induced in, neutron, 20: 18211(R) (UCLA-12-576, pp 88-111)
strontium-90 diffusion in, effects of soil composition on, 20: 18232
use of nuclear explosions in studies on, bibliography on, 20: 18855 (CEA-Bib-66)
SOLAR BATTERIES
development, 20: 19420 (N-65-25271)
development of radiation-resistant, 20: 19101(R) (N-65-19687)
development of thermionic, 20: 19421 (N-65-25406)
fabrication of p-n junction, using ion implantation technique, 20: 20125
instrumentation for thermionic, 20: 19419 (N-65-24874)
radiation effects on gallium arsenide and silicon, proton, 20: 19095 (N-65-16347)
radiation effects on silicon, electron, 20: 19105 (N-65-19870)
radiation effects on gallium arsenide and silicon, proton, 20: 19106(R) (N-65-19886)
radioinduced damage in p-type silicon, temperature dependence of electron, 20: 19115
radioinduced defects in p-type silicon, annealing of electron, 20: 19114
SOLAR FLARES
effect on ionization of nocturnal ionospheric D region, 20: 19662
effects on electron density in ionospheric F2 region, 20: 19663
electron production from, 20: 19412
prediction using perceptrons, 20: 19324 (N-65-21300)
proton emission from, correlation of satellite and ground-based observations of, (E), 20: 19351
radiation effects of simulated, on mice, gamma, 20: 18443
theory of, review of, 20: 19325 (N-65-22651)
SOLAR RADIATION
absorption of solar wind by interplanetary gases, nonadiabatic expansion for, 20: 19352
dosimetry of, during space flight, 20: 18943 (N-65-21724)
effects of, combined with uv radiation on Xanthium leaves, 20: 18391
effects on xenon-simulated, on plant leaves, 20: 18391
emission of protons, correlation of satellite and ground-based observations of, (E), 20: 19351
flux of solar wind beyond 1 a.u., method for calculating, 20: 19352
intensity variations of, correlation of ground-based and satellite measurements of, 20: 19327 (N-65-27406)
magnetic fields of streams of, effects on field of moon, 20: 19328 (NP-15939)
model of solar wind, two-fluid, 20: 19349
propagation of corpuscular, in interplanetary space, (T), 20: 19327 (N-65-27406)
properties of, review of, 20: 19645 (NASA-SP-97)
proton temperature in solar wind, measurement of, (T), 20: 19350
SOLENOIDS
power supply for, design of 104-amp, 20: 20019 (UCRL-14511-T(Rev.1))
SOLID SOLUTIONS
particles in, growth and nucleation of precipitate, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
SOLIDS
ion reactions with, studies on, 20: 20121
ion-beam reactions with, diffusion theory for depth distributions from, 20: 20126
molecular motions in, review of NMR studies of, 20: 18672
neutron scattering in, thermal, (T), 20: 19793
neutron scattering by, molecular motion measurements by, 20: 18674

positron reactions with, review of properties from, 20: 19460
radiation effects on, research summary, 20: 19273(R) (BNL-929, pp 3-43)
research, 20: 20114(R) (ORNL-3935)
research at JEEP reactor facility, 20: 20332
structure of, neutron spectroscopy for determining, 20: 20164

SOLUBILITY
radiation effects on polyacrylamide, electron, 20: 18779

SOLUTIONS
analysis for acetone and 2-butanone in aqueous, by gas chromatography, 20: 18572 (PG-Report-690)
analysis for sulfate ions using kryptonated barium carbonates, 20: 18570(R) (NYO-2757-5)
concentration measurement of, a-c bridge for, 20: 18573 (RISO-120)
radiolytic oxidation in aqueous, effects of osmium tetroxide on, 20: 18790

SOLVATION
ionic, isotope effects on, 20: 18643

SOLVENT EXTRACTION PROCESSES
development, 20: 20365
equipment design for reactor fuel processing by, 20: 18826 (UJV-1441)

SOLVOLYSIS
mechanisms of, isotope effects on, 20: 18643

SOUND
propagation in rarefied gases, kinetic theory of, 20: 19169(R) (BNL-929, pp 106-11)

SOVIET UNION
age estimation of materials and relics in, by carbon-14 method, 20: 18931
atomic energy program, 20: 20182(T) (AEC-tr-6700)
radium-226 content in lagoons and seas in, 20: 18905

SOYBEANS
radiation effects on roots of, 20: 18198
radioinduced mutations of, use in plant breeding programs, 20: 18419

SPACE
environment simulation facility for electric propulsion research, 20: 18885 (N-65-23253)
hydroxyl radical abundance in interstellar, gas-kinetic exchange reactions for, (T), 20: 19339
shock-wave stability and structure in interplanetary, (T), 20: 19326 (N-65-23194)

SPACE FLIGHT
detection of living organisms during, instrument for, 20: 18187(R) (N-65-16497)
effects on biological materials, 20: 18363
energy dissipation in tissues during, 20: 18290(R) (N-65-16483)
radiation dose estimates for Apollo, 20: 18190(R) (UCRL-16613)
radiation doses to astronauts during ninth Mercury-Atlas mission, 20: 18942 (N-65-17115)
radiation dosimetry during, effects of shielding on, 20: 18943 (N-65-21724)
radiation dosimetry during, using botanical materials, 20: 18964
radiation effects on plants during, uv, 20: 18365
radiation effects on mice in simulated, gamma, 20: 18443

SPACE VEHICLES
electronic equipment of, internal contamination of heated and irradiated components by microbes, 20: 18993 (N-65-24356)
instrumentation of Mariner C, for trapped particle detection, 20: 19034(R) (N-65-27827)
ion engines for, power supplies for, 20: 18883 (N-65-21432)
power sources for, safety aspects of nuclear, 20: 18949 (SC-DC-66-1369)
power supplies for, instrumentation for solar-thermionic, 20: 19419 (N-65-24874)
power supplies for, ancillary equipment for solar-thermionic, 20: 19420 (N-65-25271)
power supplies for, development of solar-thermionic, 20: 19421 (N-65-25406)
power supplies for, performance of 1-Mw superconducting, 20: 19424 (NASA-TN-D-3345)
power systems for use on lunar surface, status of radioisotope-fueled, 20: 19132 (N-65-24571)
power systems for, electrodeless MHD cell, 20: 19423 (N-65-27044)
power systems for, development of electric switchgear for nuclear, 20: 18851(R) (N-65-26627)
power systems for, use of fuel cells with radioisotope-fueled, 20: 19418 (N-65-22973)
propulsion system for, development of mercury-fueled ion engine, 20: 18884(R) (N-65-22975)
propulsion system for, use of oxide-coated brush cathodes in electron-bombardment ion engine, 20: 18886 (N-65-25549)
propulsion systems for, facility for testing electric, 20: 18885 (N-65-23253)
radiation doses in, during ninth Mercury-Atlas mission, 20: 18942 (N-65-17115)
radiation effects on optical properties of temperature-control coatings of, electron, 20: 19259
shielding of manned, nuclear-propelled, 20: 20093 (N-65-22849)
shielding of, bibliography on, 20: 20098 (ORNL-RSIC-12(Vol.I))

SPANISH REACTORS (JEN-1)
uses for neutron physics research and radioisotope production, 20: 20320

SPARK CHAMBERS
design and development, 20: 20365
magnet model for 2-meter, development of, 20: 19041 (SLAC-57)
spark localization in, design of field lens for, 20: 19020 (CALT-68-30)

SPECTROMETERS
control system for multiple, development of computerized, 20: 18988(R) (BNL-929, pp 58-66)

SPECTROSCOPY
bibliography on, in high-temperature chemistry of condensed phases and gases, 20: 18630 (NP-15896)
use in diagnostics of arc, plasma, (E), 20: 20010(R) (N-65-23211)

SPERM
radioinduced dominant lethals in mouse, effects of dose on x, 20: 18351
radioinduced mutations in Drosophila, x, 20: 18336

SPERMATOGENESIS
radiation effects on mitotic delay in, of *Drosophila melanogaster*, 20: 18354
radiation effects on Drosophila, x, 20: 18310

SPHALERITES
formation during ore deposition in Providencia area, Zacatecas, Mexico, geology of, 20: 18631 (NYO-2266-1)
precipitation with cadmium ions from aqueous solutions, 20: 18631 (NYO-2266-1)

SPHERES
contraction of helium-hydrogen, physical conditions in, (T), 20: 19345

SPINAL CORD
radiation injuries of, induced by therapy, 20: 18406

SPLEEN
erythropoietic activity of, in lethally irradiated mice injected with bone marrow, 20: 18295(R) (UCLA-12-576, pp 27-56)
extracts of γ-irradiated, effects on nitrogen metabolism in frog liver, 20: 18207 (NIJS-R-473)
radiation effects on DNA and RNA metabolism in cells of rat, x, 20: 18341
radiation effects on concentration of oxidized and reduced TPN in rat, x, 20: 18343
radiation effects on mouse, γ and proton, 20: 18364
radiation effects on cell reproduction in mouse, survival curve analysis of γ, 20: 18370
radiation effects on dehydrogenase and transaminase activity in mouse, 20: 18280
radioinduced mononucleated giant erythropoietic cells in fragments from, mechanism for x, 20: 18325
radiosensitivity effects of homogenates from mouse, x, 20: 18433
radiosensitivity effects of tissue extracts of, on mouse tumor, 20: 18460
radiosensitivity effects of extracts of calf, 20: 18493
radiosensitivity effects of lyophilized extracts of calf, in rat, 20: 18497
strontium-90 retention in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
surgical removal of mouse, radiosensitivity effects on fetuses, 20: 18436

SPONTANEOUS FISSION
review, 20: 19992

SPORES
radiation effects on *Bacillus cereus*, x, 20: 18344
radiation effects on *Bacillus megaterium*, effects of hydrogen sulfide and nitric oxide on, 20: 18434
radiosensitivity of Clostridium, γ, 20: 18340
use as radiation dosimeter during space flight, 20: 18964

SPUTTERING
model for calculations of, 20: 19407
research progress, 20: 19359(R) (N-65-24388)

SQUIRRELS
radiation effects on ground, gamma and x, 20: 18291(R) (N-65-17058)

STABLE ISOTOPES
conference on, German Academy of Sciences, Oct. 28 to Nov. 2, 1963, Leipzig, 20: 19120

STAINLESS STEEL
corrosion by anisole–boron trifluoride, evaluation of, 20: 19135(R) (K-C-718)
corrosion by water at high temperatures, 20: 20183
diffusion of carbon into type 316, from Croloy 9M in composite tubing, 20: 19189 (N-65-21161)
fabrication of cylinders of, using magnetic fields, 20: 19199 (RT/EL-(65)9)
iron-57 K-conversion Mössbauer spectrum in, (E), 20: 19847
performance as fuel cladding under coolant-loss conditions, 20: 20221
reactions of type 304, with uranium nitride at 1000 to 1350°C, 20: 19187

(BMI-1760)
reactions of type 300 series; with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
reactions with chlorine trifluoride and hydrofluoric acid, 20: 18824(R) (EURAEC-1536)
reactions with hydrofluoric acid–oxygen mixtures at high temperatures, 20: 18824(R) (EURAEC-1536)
surface temperature of, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
stainless steel–ZrB_2, fabrication of dispersions of, process development for, 20: 19177(R) (BMI-1757)
STANDARDS
establishment of, for glove box evaluation and testing, 20: 18947 (RFP-343)
STANFORD LINEAR ACCELERATOR
magnets for, electric and magnetic properties of quadrupole, 20: 19304 (SLAC-55)
power supplies for, design of c-w, 20: 19290 (CALT-68-64)
STANNATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
STARS
beryllium abundance in F- and G-type dwarf, lithium/beryllium value from, (E), 20: 19330
contraction of helium-hydrogen, physical conditions in, (T), 20: 19345
detection of radio-source, hidden by moon, 20: 19348
distribution of Cepheid, in large population-I-component galaxies, (T), 20: 19334
effects of quasi-stellar-radiosource, on universe models, (T), 20: 19354
energy source for quasi-stellar radio-source, monopole gravitational field as, 20: 19714
evolution of, from main sequence through core helium burning, (T), 20: 19335
evolution of, from main sequence through core helium burning, (T), 20: 19334
evolution of, from main sequence through core helium burning, (T), 20: 19336
formation rates of, two-color diagram for, (T), 20: 19347
identification of quasi-stellar radio sources, 20: 19340
magnetic fields of polytropic, equilibrium, (T), 20: 19343
metal abundances in, two-color diagram for, (T), 20: 19347
models for massive hot, in general relativity, 20: 19333
nucleosynthesis in γ Pavonis and ζ^1 Reticuli, element underabundance in, (T), 20: 19337
properties of quasi-stellar radio-source, review of, 20: 19353
STATISTICS
methods in, for plant dynamics analysis, 20: 18878
use for nuclear-decay distributions, 20: 19851
use for radiation detector performance, 20: 19851
use of error, for radiation detector time determination, 20: 19053
use of error, for scintillation detector performance, 20: 19054
value prediction for unobservable random variables, 20: 19169(R) (BNL-929, pp 106-11)
STEAM
corrosive effects on welded joints of niobium–zirconium alloys, 20: 19195
production in pressurized water reactors without heat exchanger, 20: 20285(P)
reactions with graphite at 1300 to 1600°F, 20: 19191 (ORNL-TM-1430)
separation from water, performance of radial-vane separator for, 20: 18864 (GEAP-4935)
simulation of superheated, for neutron moderation studies, 20: 20216
steam–H_2O, flow in vertical tubes, 20: 18869(R) (NYO-3114-10)
steam–water, phase velocity distribution for flowing systems of, 20: 18874
steam–water, void fraction measurement using acoustic methods, 20: 20187 (EURAEC-1361)
STEEL
coating with uranium oxide by electrolysis, effects of electrolyte on, 20: 18691
corrosion by salt spray, measurement of, by x-ray induction method, 20: 19196
effects of abdominal shielding of, on survival of irradiated rats, 20: 18441
gamma attenuation factors for, (E), 20: 20094 (NP-15926)
welds in thick plates of, betatron detector with scintillation counters for inspection of, 20: 19233
STELLARATORS (C)
development status of, 20: 20365
STEROIDS
radiation effects on content in blood of burros, neutron, 20: 18296(R) (UCLA-12-576, pp 57-60)
radiosensitivity effects of methandrostandiol, in mice and rats, 20: 18477
STEROIDS, 17-KETO-
excretion of tritium-labeled, after injection of labeled testosterone, 20: 18230
STILBENE
radiolysis of, effects of naphthalene, phenanthrene, and triphenylene on isomerization in, 20: 18735
STILBENE, 4,4'-DIPHENYL-
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
STILBENES
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
STOCHASTIC METHODS
models for distribution of radioactive materials in compartmental biological systems, 20: 18427 (ORNL-3920)
STRAIN GAGES
use in materials testing and stress analysis of pressure vessels, 20: 18880 (Y-RD-5)
STREPTOMYCIN
radiosensitivity effects on yield of temperature-sensitive mutations in Paramecium, x, 20: 18349
STRESS ANALYSIS
of plates, drive system for determining, 20: 18879 (AWRE-O-21/66)
STRONTIUM
content in calcites in Providencia area, Zacatecas, Mexico, 20: 18631 (NYO-2266-1)
content in calcite crystals from lead–zinc deposits, 20: 18631 (NYO-2266-1)
content in marine aragonite oolites and sea water, 20: 18631 (NYO-2266-1)
content in Triassic reef in Austrian Alps, theory of recrystallization mechanism from, 20: 18631 (NYO-2266-1)
diffusion in synthetic zeolites, tracer studies of kinetics of self-, 20: 18686
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
excretion of, effects of chelates on urinary, 20: 18209 (TID-22717)
ion exchange reactions with hydrogen on ferrocyanide molybdate, kinetics of, 20: 18564 (EUR-2748.e)
metabolism in man, 20: 18185(R) (BNL-929, pp 126-47)
separation from cesium by electrodialysis, 20: 18842
separation from contaminated solutions by coprecipitation with barium sulfate, 20: 18579 (UJV-1489)
separation from rare earths by ion exchange chromatography, 20: 18827
sorption by barium sulfate–calcium sulfate systems, 20: 18835
uptake by plants, effects of calcium on, 20: 20360(R) (PRNC-73)
STRONTIUM COMPLEXES
with 2,6-pyridinedicarboxylic acid, ion exchange properties of, 20: 18685
STRONTIUM IONS
precipitation with aragonite and calcite from aqueous solutions, 20: 18631 (NYO-2266-1)
STRONTIUM ISOTOPES
isotopic mixing constants of, volume, (T), 20: 19970
STRONTIUM ISOTOPES Sr-85
body burdens in mice and rats, effects of sodium salicylate on, 20: 18229
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
plasma and renal clearance in man, 20: 18226
uptake by bone, use in diagnosing bone cancer, 20: 18513
uptake by plants growing in peat-podzolic soils, effects of liming on, 20: 18303
STRONTIUM ISOTOPES Sr-86
energy levels from rubidium-86 decay, (E), 20: 19858
STRONTIUM ISOTOPES Sr-87
content in zircons, age estimation from, 20: 18924(R) (NYO-1669-11)
energy levels of, structure from isomeric transition in, (T), 20: 19970
STRONTIUM ISOTOPES Sr-88
deuteron reactions (d,p) at 7 Mev, proton spectra from, (T), 20: 19826 (MIT-2098-229)
proton scattering by, energy level studies from, (T), 20: 19826 (MIT-2098-229)
STRONTIUM ISOTOPES Sr-89
content in atmosphere, soil, and food in U. S., 1963 to 1965, 20: 18980
content in diet in U. S., 1961 through 1964, 20: 18920
content in milk after nuclear accident, 20: 18969
diffusion in soil, effects of compaction on, 20: 18816
energy levels of, parity and spin of, (T), 20: 19826 (MIT-2098-229)
STRONTIUM ISOTOPES Sr-90
content in atmosphere, soil, and food in U. S., 1963 to 1965, 20: 18980
content in cow's milk, measure for moderating, 20: 18985
content in diet in U. S., 1961 through 1964, 20: 18920
content in foods, 1962 through 1964, 20: 18915

content in grain and oil-bearing plants, 20: 18906(T)
content in human bones in Scotland and United Kingdom, 20: 18922
content in milk after nuclear accident, 20: 18969
content in milk in Calif. 1960 to 1963, 20: 18968
content in plant tissues, 20: 18906(T)
content ratio to calcium in mouse tissues, 20: 18225
determination in sea water in Genoa, Italy, radiometric, 20: 18592
diffusion through soil, effects of soil composition on, 20: 18232
dosimetry in mice after intraperitoneal injection, 20: 18353
dosimetry of, equation for internal, 20: 18955
effects on animals and man, 20: 18198
effects on blood picture in mice, 20: 18353
effects on cutaneous angiomas, 20: 18528
effects on mice after intraperitoneal injection, 20: 18353
effects on pituitary gland, 20: 18532
metabolism in mice after intraperitoneal or subcutaneous injection, 20: 18225
motion in Atlantic Ocean, vertical, 20: 18930
properties of radioapplicators of yttrium-90 and, 20: 18522
storage of wastes of, packaging facilities for, 20: 20348 (RL-SA-60)
uptake by marine organisms, correlation with buildup factor, 20: 18215
uptake by pasture grass, effects of calcium content of soil on, 20: 18232
uptake by plants growing in peat-podzolic soils, effects of liming on, 20: 18303
uptake by wheat, effects of variety on, 20: 18970
uptake from milk by rats, effects of physico-chemical state on, 20: 18224

STRONTIUM NITRATES
radioinduced free radicals in, EPR studies of, 20: 18739
sorption by glass surfaces, 20: 18846

STRONTIUM URANATES
crystal structure of Sr_3UO_6, 20: 19223

STYRENE
acrylonitrile–styrene, radioinduced graft polymerization onto cellulose, 20: 18799(P)
butadiene–styrene, radioinduced grafting onto cellulose, 20: 18798(P)

STYRENE POLYMERS
radiation effects on dielectric constants and paraelectric susceptibility of, 20: 19266

SUCCINAMIDE
radioinduced free radical formation in, ESR and tracer studies of, 20: 18757

SUCCINIC ACID
dithio-, radiosensitivity effects in guinea pigs and mice, 20: 18483

SUCCINIMIDE, *N*-VINYL-
radioinduced solid-state polymerization of, with succinimide, 20: 18776

SUCCINIMIDES
radioinduced solid-state polymerization with *N*-vinylsuccinimide, 20: 18776

SUGARS
radiosensitivity effects on catalase, 20: 18449

SULFANILAMIDE
radiosensitivity effects on plant seeds, β, 20: 18442

SULFATE IONS
determination in aqueous solutions using kryptonated barium carbonate, 20: 18570(R) (NYO-2757-5)

SULFATES
effects on thorium dioxide–uranium dioxide fuel particle solubility in fluoride–nitric acid solutions, 20: 18819 (AAEC/E-143)
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

SULFIDES
synthesis of sulfonyl, for testing as radioprotective compounds, 20: 18424

SULFITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748

SULFONATES
synthesis of, for testing as radioprotective compounds, 20: 18424

SULFONES
radiosensitivity effects on plant seeds, β, 20: 18442

SULFONIC ACIDS
ethylmethyl, effects on mutations in maize, 20: 18184(R) (BNL-929, pp 115-25)
radiation effects on ion exchange resins of, gaseous evolution in gamma, 20: 18728 (NIJS-R-458)

SULFOXIDES
association with phenols, 20: 20360(R) (PRNC-73)
preparation and reduction of, 20: 20360(R) (PRNC-73)

SULFUR
determination in biological materials, by precipitation using barium-139 and gamma counting, 20: 18609
determination in mixture with phosphorus, activation, 20: 18569 (NP-15887)
determination in thorium nitrate, methods for, 20: 18568(R) (NBL-230)
ionization equilibria in sun, (T), 20: 19338

SULFUR COMPOUNDS
complex formations by, 20: 18449
radiosensitivity effects of, reaction mechanisms for, 20: 18274

SULFUR DIOXIDES
radiation effects on evolution of, from sulfonic acid ion exchange resins, 20: 18728 (NIJS-R-458)
radioinduced polymerization with vinyl acetate, 20: 18774

SULFUR FLUORIDES
Ar–SF_6, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)

SULFUR ISOTOPES
content in marine environment, biogeochemical studies on, 20: 18893 (NYO-3450-1, pp 131-48)
content in meteorites, 20: 18909
content in volcanic materials from Australia, New Zealand, and the Pacific, 20: 18909
separation and preparation of targets at ORNL calutron, 20: 19153

SULFUR ISOTOPES S-32
energy levels of, parity and spin of, (T), 20: 19816 (INP-441/PL)
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))

SULFUR ISOTOPES S-34
proton reactions (p,γ) at 1.9 to 3.0 Mev, chlorine-35 resonance levels from, (E), 20: 19973

SULFUR ISOTOPES S-35
beta decay of, internal bremsstrahlung spectra from, (T), 20: 19949
uptake by bones, effects of radioprotective compounds on, 20: 18479

SULFUR MINERALS
geochronology of hypogene sulfide deposits, 20: 18924(R) (NYO-1669-11)

SULFUR SYSTEMS
P–S, analysis for phosphorus and sulfur, activation, 20: 18569 (NP-15887)

SULFURIC ACID
effects on gamma radiolysis of 2-propanol, 20: 18766
effects on spectra of uranium(III), 20: 18653
radiolysis in ferrous solutions, yields of products of, 20: 18745
radiolysis of iron-containing solutions of, performance of, for low-level gamma dosimetry, 20: 18793

SUN
activity data from Jan. to Sept. 1965, 20: 19679
boron abundance in, photometric scan for determining, (E), 20: 19331
corona of, radiobursts for determining magnetic field intensity and physical properties of, 20: 19355
evolution of planetary system of, chemical evidence relative to, 20: 19346
hydrogen emission from, geomagnetic storm mechanism theory of, 20: 19687
ionization equilibria in, (T), 20: 19338
nickel abundance in atmosphere of, (T), 20: 19332
spectra of corona of, polarization of forbidden line λ 5303, (T), 20: 19329
spectra of corona of, polarization of forbidden lines in, 20: 19329
spot activity correlations with ionospheric electron density and uv and x radiation intensity, 20: 19647
spot cycle variation in, geomagnetic activity correlation with double, (E), 20: 19678
spot data for Sept. 1965, 20: 19679
x-ray spectra from, isothermal quiet-corona model for line intensities in soft, 20: 19338

SUPERCONDUCTIVITY
book: *Superconductivity of Metals and Alloys*, 20: 19773(T)
conference, 20: 19774
in rings interrupted by insulating junctions, 20: 19770
of metals, effects of communal entropy of crystal structure on, 20: 19734
theory of surface, 20: 19273(R) (BNL-929, pp 3-43)

SUPERCONDUCTORS
cooling system for magnet coils of, design of cryostat for, 20: 19731
current distribution in thin film transmission lines of, (T), 20: 19725 (NASA-TN-D-3344)
current transmission through barriers in, long-range order effects from, (T), 20: 19726
current vortex motion in, effects of, (T), 20: 19746
design of 30 kG magnet coils of, 20: 19736
development, 20: 20365
dislocation damping in type II, 20: 20113(R) (NYO-3001-1)
electric conductivity in intermediate state of type-I, vortex-motion mechanism for, (E), 20: 19743
electric fields in moving vortex cores in type-II, dissipation from, (T), 20: 19747
electron band structure and transition temperature of cadmium–indium, 20: 19764

electron tunneling in lead junction, magnetic-field dependence of $2\Delta/n$ structure in, (E), 20: 19739
electron tunneling in aluminum–lead junction, structure from recombination effects on, (E), 20: 19744
electron-spin pairing in single crystals of vanadium silicide, 20: 20152
forces on thin films of tin, in magnetic fields, mechanical, (E), 20: 19765
Ginzburg-Landau parameter for type-I, 20: 20177(R) (BNL-929, pp 83-105)
magnetic flux entry into Meissner state of type-II, maximum field for delay of, (T), 20: 19748
magnetic hysteresis loops in, intrinsic properties of, (E), 20: 19741
magnetic moment produced by rotating, measurement of, 20: 19771
magnetization of irreversible, flux gradient instability in, (E), 20: 19745
magnetization of niobium–zirconium, effect of external current on, (E/T), 20: 19735
microwave reflection and transmission coefficients of thin-film, 20: 19772
microwave surface resistance in copper-plated lead–indium, intrinsic hysteresis in, (E/T), 20: 19752
performance in electric generators for space vehicles, 20: 19424 (NASA-TN-D-3345)
phase transition in type-II, thermal nature of a-c, 20: 19753
polarization in vanadium silicide, electronic and nuclear, 20: 20109(R) (MIT-3031-3)
power losses in bismuth–lead eutectic alloy, surface nature of a-c, 20: 19742
properties of niobium–zirconium alloy, (E), 20: 19722 (N-65-17099)
suspension of spheres of, in magnetic fields, (E), 20: 19728
thermal conductivity from impurity scattering for overlapping-band, (T), 20: 19763
transition temperature of niobium and vanadium, pressure dependence of, (E), 20: 19762
transition temperatures of mixed titanates, (E), 20: 19767
transitions in lead film, anomalies and surface effects in resistive, (E), 20: 19749
ultrasonic attenuation in lead, anomalies of, (E), 20: 19766
use in high-field magnets, 20: 19724 (N-65-25286)
use of thin film, in fast storage devices, 20: 19720 (CEA-Bib-65)
vortex displacement in, losses from, (T), 20: 19738

SUPERFLUIDITY
conference, 20: 19774
density fluctuations in dilute Bose systems, correlation of, (T), 20: 19768

SUPERHEATERS (NUCLEAR)
operation problems in BWR, 20: 20275

SURFACE WATERS
dispersion and movement in Cape Kennedy area, physical processes of, 20: 20359 (NYO-2973-1)
radioactive contamination of, 20: 18976
radioactivity in U. S., 1965, 20: 18915
radioactivity in, 1965, 20: 18914
radioactivity in, 1965, 20: 18918
radioactivity in, Jan. to July, 1965, 20: 18972
strontium-90 content in, 1964 and 1965, 20: 18914

SURFACES
radiation dosimetry at interfaces of, γ and x, 20: 18952
thermal conductivity of contacting, in vacuum, (T), 20: 18867 (NP-15897)

SURGERY
hazards of dental, in irradiated patients, 20: 18308
radiosensitivity effects of spleen, in fetal mice, 20: 18436

SWIMMING POOL REACTORS
operation of, for activation analysis of trace metals in sea water, 20: 18576(R) (TID-22660)
radioisotope production and handling at GRR-1, 20: 20339
reactivity transfer function for SAPHIR, analyzer for measuring, 20: 20311 (EIR-87)
research programs on neutron cross sections and scattering at FRM, 20: 20331
use of Greek GRR-1, for chemistry studies, 20: 20337

SWINE
fission product metabolism in, 20: 18188(R) (ORO-635)
radiation effects on, pathological γ and neutron, 20: 18188(R) (ORO-635)
radiation effects, 20: 18198

SWITCHES
development for nuclear space power systems, 20: 18851(R) (N-65-26627)

SYNCHROCYCLOTRONS
beam pulse duration in proton, system for increasing, 20: 19298 (JINR-P-2281)
design modification of CERN 600-Mev, 20: 19307
use on-line with isotope separator for nuclear decay studies, 20: 19885

SYNCHROTRONS
beam current restrictions from limiting particle density in phase volume, (T), 20: 19302 (NP-15796)
beam energy meter for, calibration of, 20: 19291 (CALT-68-67)
beam monitoring system for CERN, design of, 20: 19292 (CERN-66-5)
beam profile measurements using photographic plates, 20: 19289 (CALT-68-20)
magnet power supplies for, flat topping of, 20: 19303 (PPAD-581D)

SYNERGISTIC ACTION
radiation and magnetic field, on plant germination, x, 20: 18388

SYSTEMS FOR NUCLEAR AUXILIARY POWER
coolant and power cycles for, review of liquid metal use in, 20: 20303
development of, hearings before Joint Committee on Atomic Energy on, 20: 20305
disposal of orbiting, techniques for ocean burial, 20: 20302 (SC-RR-65-472)
safety aspects of, 20: 18949 (SC-DC-66-1369)

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-8)
coolant velocity in, noise and analysis techniques for determining, 20: 20297 (NAA-SR-11193)

SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-10)
development of, hearings before Joint Committee on Atomic Energy on, 20: 20305
disposal of orbiting 10A, techniques for ocean burial, 20: 20302 (SC-RR-65-472)
neutron detector for 10A, development of semiconductor, 20: 20298 (NAA-SR-11762)

SZILARD-CHALMERS REACTIONS
chromium-51 enrichment by, 20: 18812
uses in separation of radioisotopes from neutron-irradiated biological materials in activation analysis, 20: 18583

T

TANTALUM
conversion-electron emission from xenon-133 in monocrystalline, 20: 20129
corrosion by molten plutonium alloys, 20: 20239(R) (LA-3482)
corrosion of, measurement of, by beta backscattering and x-ray induction, 20: 19196
determination in plutonium and uranium alloys, spectrophotometric, 20: 18565 (LA-3465)
diffusion of radioactive rare earths in, isotope-separator on-line preparation for, 20: 20138
krypton-85 distribution with depth in ion-bombarded foils of, 20: 18570(R) (NYO-2757-5)
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
oxidation by water vapor at 1 and 8 torr, 20: 19197
oxidation to 1800°C, kryptonate method for studying, 20: 18570(R) (NYO-2757-5)
preparation of kryptonated, by ion bombardment, 20: 18570(R) (NYO-2757-5)
proton scattering by monocrystalline, orientation dependence of yield of Rutherford, (E/T), 20: 20131
radiation effects on, annealing of neutron, 20: 19267
radiation effects on, at 4.5°K, effect of oxygen concentration on annealing of neutron, 20: 19268
radiation effects on capacitors of, 20: 19103 (N-65-19758)
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
surface temperature of, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
use as screens for image intensification during diagnostic radiography, 20: 18518

TANTALUM ALLOYS
Hf–Ta–W, analysis for alloying elements and impurities, comparison of results from 25 laboratories on T-111, 20: 18567 (MAB-217-M)
Nb–Ta–W–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on FS-85, 20: 18567 (MAB-217-M)
Ta–Th–W, development of oxidation-resistant, 20: 19193
Ta–W, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Ta–W, corrosion by molten plutonium alloys, 20: 20239(R) (LA-3482)
Ta–W, reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)

TANTALUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702

TANTALUM CARBIDES
TaC–UC, evaporation of, rate of vacuum, 20: 19212(R) (N-65-21351)

TANTALUM ISOTOPES Ta-182
nuclear data, 20: 19879

TANTALUM ISOTOPES Ta-183
nuclear data, 20: 19880

TANTALUM ISOTOPES Ta-184
nuclear data, 20: 19881
TANTALUM ISOTOPES Ta-185
nuclear data, 20: 19882
TANTALUM NITRIDES
deposition of thin films of, by sputtering, vacuum equipment for continuous, 20: 19201
electric properties of thin films of, effects of sputtering parameters on, 20: 19201
sputtering thin films of, 20: 19201
TANTALUM OXIDES
xenon-125 ranges in, 20: 20136
TANTALUM SYSTEMS
C–Hf–Ta, phase studies at 2050°C, 20: 19213 (N-65-21739)
C–Ta, corrosion by molten plutonium, 20: 20239(R) (LA-3482)
Ta–ThO_2–W, development of oxidation-resistant, 20: 19193
Ta–ThO_2–W–Zr, development of oxidation-resistant, 20: 19193
TASTE
radiation effects on papaya, γ, 20: 18247(R) (UH-23SPS-1, pp 14-25)
radiation effects on, measurement in rats of x, 20: 18294(R) (TID-22766)
radiation effects on pineapple, gamma, 20: 18299(R) (UH-23SPS-1, pp 47-51)
TBP PROCESS
waste fixation in, computer program for glass composition for, 20: 20346 (ORNL-3824)
TECHNETIUM
separation from molybdenum by sorption by charcoal or coal, 20: 18830
separation from molybdenum spallation products by precipitation with tetraphenylarsonium perrhenate, 20: 18843
TECHNETIUM ALLOYS
Tc–W, thermoelectric properties, 20: 20185 (CONF-650204-9)
TECHNETIUM ISOTOPES Tc-99
decay of, local energy deposition due to electron-capture and internal conversion, 20: 18958
determination of isomer of, by autoradiographic measurement of half life using ring oven methods, 20: 18584
differentiation from molybdenum-99 in rabbits, effects on gamma counting rate, 20: 18213
distribution in rabbit tissues, 20: 18509(R) (UCLA-12-576, pp 61-80)
performance as scanning agent for reticulo-endothelial system, 20: 18185(R) (BNL-929, pp 126-47)
production of isomer of, by irradiation of molybdenum, 20: 18830
TECHNICAL REPORTS
list of BNL, 1965, 20: 20354(R) (BNL-929)
list of Puerto Rico Nuclear Center, 20: 20360(R) (PRNC-73)
TEETH
extraction from irradiated patients, hazards of, 20: 18308
extraction techniques for monkey, 20: 18289(R) (LA-3432, pp 56-101)
TELEVISION EQUIPMENT
use for diagnostic radiography, 20: 18510
TELLURATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
TELLURITES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
TELLURIUM
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
radiolytic oxidation of aqueous solutions of, effects of osmium tetroxide on, 20: 18790
tellurium-125 Mössbauer effect in, (E), 20: 20148
TELLURIUM FLUORIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148
TELLURIUM IODIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148
TELLURIUM ISOTOPES Te-122
energy levels from antimony-122 beta decay, (E), 20: 19960
TELLURIUM ISOTOPES Te-125
energy levels of, structure from isomeric transition in, (T), 20: 19970
Mössbauer effect in, (E), 20: 20148
TELLURIUM ISOTOPES Te-127
energy levels of, structure from isomeric transition in, (T), 20: 19970
TELLURIUM ISOTOPES Te-128
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979
TELLURIUM ISOTOPES Te-129
energy levels of, structure from isomeric transition in, (T), 20: 19970
TELLURIUM ISOTOPES Te-133
energy levels of, structure from isomeric transition in, (T), 20: 19970
TELLURIUM OXIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148
TEMPERATURE
control and measurement of, bibliography on, 20: 19216 (NP-15388)
effects on mine stability and plastic flow in salt deposits, 20: 18897 (ORNL-P-2006)
effects on mitosis in γ-irradiated turtles, 20: 18291(R) (N-65-17058)
effects on separation of hydrogen isotopes by ion exchange on zeolites, 20: 18589
effects on spectroscopy in chemistry of condensed phases and gases, bibliography on, 20: 18630 (NP-15896)
measurement of low, performance of carbon resistors for, 20: 19721 (CLM-R-47)
radioinduced Paramecium mutations sensitivity to, conditions affecting yield of x, 20: 18349
radiosensitivity effects on *Artemia salina* oocytes, x, 20: 18447
radiosensitivity effects on skin, 20: 18454
radiosensitivity effects on erythrocyte membranes, 20: 18454
sensitivity to, in radioinduced mutations in Paramecium, 20: 18348
TEMPERATURE CONTROL
system for low temperatures, design of, 20: 20168
TERBIUM
separation from americium and curium by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from magnesium chloride solutions by solvent extraction using triisooctylamine, 20: 18562(R) (EUR-2640.e)
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-n-hexylphosphine oxide), 20: 18599
TERBIUM ALLOYS
Ge–Tb, crystal structure of, at or near equiatomic proportions, 20: 19225
Ge–Tb, preparation and crystal structure of TbGe, 20: 19224
Mn–Tb, magnetic structure of intermetallic compound $TbMn_2$ in, 20: 18556(R) (BNL-929, pp 66-82)
TERBIUM COMPLEXES
with EDTA, radioinduced fluorescence in, in light and heavy water, uv, 20: 18683
TERBIUM ISOTOPES Tb-160
beta decay of, dysprosium-160 levels from, (E), 20: 19846
TERBIUM OXIDES
Pr_2O_3–Tb_2O_3, phase studies, 20: 18697
TERBIUM SILICIDES
preparation and crystal structure of, 20: 19224
TERBIUM SULFIDES
Cu_2S–Tb_2S_3, phase studies, 20: 18644
TERPHENYL
determination in nitrogen of pressurization, method for, 20: 18560 (EUR-2454.f)
heat transfer failure mechanisms of HB-40 and Santowax OM, in fuel bundles, 20: 20189
preparation of carbon-14-labeled, methods for, 20: 18803 (EUR-2527.d)
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752
TESTOSTERONE
injection of tritium-labeled, urinary excretion of labeled estrogens and ketosteroids after, 20: 18230
TETRANEUTRONS
production of, review of attempts at, 20: 19982
TEXTILES
radiation effects on polyamide, gamma, 20: 19747
THALLIUM
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
separation from rare earths by ion exchange chromatography, 20: 18827
THALLIUM ALLOYS
In–Tl, indium-115 NMR in liquid, 20: 20157
THALLIUM CHLORIDES
separation from solutions by solvent extraction, stability constants in, 20: 18556(R) (BNL-929, pp 66-82)
THALLIUM ISOTOPES
mass spectra from proton reactions with lead, use of isotope separator for, 20: 19889
THALLIUM ISOTOPES Tl-202
production of isomeric, in neutron activation of thallium at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
THALLIUM ISOTOPES Tl-203
separation from thallium-205 using LNR-JINR mass spectrometer, 20: 19156
THALLIUM ISOTOPES Tl-204
deposition on platinum anode, effects of hydrogen ion concentration on, 20: 18676
production of isomeric, in neutron activation of thallium at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
THALLIUM ISOTOPES Tl-205

separation from thallium-203 using LNR-JINR mass spectrometer, 20: 19156
THALLIUM ISOTOPES Tl-208
electric charge of recoil atomic, from bismuth-212 alpha decay, (E), 20: 19867
THALLIUM OXIDES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
THERMAL CONDUCTIVITY
between surfaces at solid-solid contact, 20: 19238
of contacting surfaces in a vacuum, (T), 20: 18867 (NP-15897)
prediction of, methods for, 20: 20365
THERMAL RADIATION
effects on rats, synergism with x rays, 20: 18184(R) (BNL-929, pp 115-25)
THERMAL REACTORS
fuel performance in, plutonium, 20: 20231 (BNWL-SA-547)
fuel production by recycling in, plutonium-238, 20: 19133 (DUN-SA-4)
fuel production in, plutonium-238, 20: 19134 (DUN-SA-5)
THERMAL STRESSES
distribution in reactor fuel rods, radial, 20: 20201(R) (ANL-7110, pp 311-401)
THERMIONIC CELLS
design for testing cathodes, 20: 19209(R) (N-65-21348)
development of high-temperature ceramic rectifiers and thyratrons, 20: 19416(R) (N-65-17881)
development of liquid-metal cooled, 20: 20303
development of tungsten-clad uranium carbide as cathodes for, 20: 19207(R) (N-65-21346)
development of uranium carbide–zirconium carbide as cathodes for, 20: 19207(R) (N-65-21346)
electric characteristics of cesium-filled, (E), 20: 19425
electric conductivity of insulators in cesium-filled, sorption effects on, (E/T), 20: 19422 (N-65-26628)
fabrication of clad carbide cathodes for, methods for, 20: 19210(R) (N-65-21349)
ion oscillations in, effects on power output, 20: 20201(R) (ANL-7110, pp 311-401)
plasma production in, methods of, 20: 19415 (N-65-16645)
THERMOCOUPLES
development and testing of in-pile, 20: 20185 (CONF-650204-9)
THERMODYNAMIC PROPERTIES
calculations for isotopes, quantum mechanics of, (E/T), 20: 18656
THERMOMETERS
design for large reactor coolant monitoring, 20: 20186 (DP-834)
properties of brass, for measurements below 1°K, 20: 19729
THERMONUCLEAR REACTORS
development in Soviet Union, 20: 20182(T) (AEC-tr-6700)
development status of Astron, 20: 20365
fuel economy in, factors affecting, 20: 20177(R) (BNL-929, pp 83-105)
THERMOPILES
performance for burnout onset detection in rod clusters, 20: 18859 (AEEW-R-432)
THICKNESS GAGES
use of radioisotope, for estimation of plant forage yields, 20: 19119
THIOLS
effects on biological systems, chemical, 20: 18453
radiosensitivity effects of amino-, mechanism for x, 20: 18431
radiosensitivity effects in bacteria, 20: 18481
reactions with disulfides, 20: 18276
synthesis of, for testing as radioprotective compounds, 20: 18424
THIOSULFATES
radiolysis of aqueous solutions of, at 77°K, yields of hydrogen from gamma, 20: 18748
THOREX PROCESS
mixer-settler performance in, 20: 18823 (DP-1022)
THORIUM
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
determination in human urine, method for, 20: 18805 (SZS-12(1965))
determination in plutonium and its alloys and compounds, spectrophotometric, 20: 18566 (LA-3469)
determination in sintered thorium dioxide and thorium dioxide–uranium dioxide, method for, 20: 18577 (TID-22670)
determination in uranium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
determination of, biamperometric indication in direct chelometric, 20: 18588
determination of, using triphenylarsine oxide, 20: 18607
determination using cerium chelate of 1,2-cyclohexylenedinitrilotetraacetic acid, spectrophotometric, 20: 18598
neutron resonance capture by, effects of temperature on, 20: 20183
oxidation by water vapor at 1 and 8 torr, 20: 19197
sample preparation procedures for, metallographic, 20: 19176 (ANL-6975)
separation from irradiated thorium dioxide, mixer-settler performance in Thorex Process for, 20: 18823 (DP-1022)
separation from nitric acid solutions by solvent extraction using tertiary amines, 20: 18829
separation from rare earths by ion exchange chromatography, 20: 18827
separation from rare earths and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
separation of uranium-233 from irradiated, mixer-settler performance in Thorex Process for, 20: 18823 (DP-1022)
THORIUM ALLOYS
sample preparation procedures for, metallographic, 20: 19176 (ANL-6975)
Pb–Th, thermodynamic properties of intermetallic compounds in, vapor pressure studies of, 20: 19244
Ta–Th–W, development of oxidation-resistant, 20: 19193
THORIUM BORIDES
thermodynamic properties at 800 to 950°C, 20: 20177(R) (BNL-929, pp 83-105)
THORIUM BROMIDES
complexes with carbamide in methanol solutions, properties of, 20: 18647
THORIUM CARBIDES
electric properties, 20: 20177(R) (BNL-929, pp 83-105)
THORIUM CHLORIDE COMPLEXES
with carbamide, in methanol solutions, properties of, 20: 18647
THORIUM CHLORIDES
preparation and properties of alcoholates of, 20: 18671
solubility of isopropylate of, in non-aqueous solvents, 20: 18670
THORIUM COMPLEXES
with amines, thermodynamic properties of nitrate, 20: 18829
THORIUM(IV) FLUORIDES
free energy of formation, 20: 20177(R) (BNL-929, pp 83-105)
THORIUM IODIDES
complexes with carbamide in methanol solutions, properties of, 20: 18647
THORIUM IONS
reactions with tungstate ions, electrometric studies of, 20: 18650
THORIUM ISOTOPES
deposition of ThB + C + C′ on thin wires, device for, 20: 18806
separation and processing using ORNL calcutrons, 20: 19165
THORIUM ISOTOPES Th-230
content in mollusks from raised marine terraces, age estimation from, 20: 18925 (NYO-3450-1, pp 1-27)
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
energy levels of, high-spin rotational, (E/T), 20: 19953
THORIUM ISOTOPES Th-232
energy levels of, high-spin rotational, (E/T), 20: 19953
evolution with lead in Earth's crust, 20: 18894 (NYO-3450-1, pp 169-84)
use in fuel elements for pressurized boiling light water reactor, 20: 20223(P)
THORIUM ISOTOPES Th-234
excretion of, from efficacy of EDTA, DTPA, and TTHA for promoting, 20: 18438
THORIUM NITRATES
analysis for sulfate sulfur, methods for, 20: 18568(R) (NBL-230)
sorption by glass surfaces, 20: 18846
THORIUM(IV) OXIDES
analysis for thorium by hydridation and decomposition, chromatographic, 20: 18577 (TID-22670)
analysis for uranium and yttrium, x-ray spectrographic, 20: 18558 (AECL-2526)
performance for insulating in-pile thermocouples, 20: 20185 (CONF-650204-9)
separation of thorium and uranium-233 from irradiated, mixer-settler performance in Thorex Process for, 20: 18823 (DP-1022)
BeO–PuO_2–ThO_2, fabrication of dispersions of, process development for, 20: 19177(R) (BMI-1757)
Ta–ThO_2–W, development of oxidation-resistant, 20: 19193
Ta–ThO_2–W–Zr, development of oxidation-resistant, 20: 19193
ThO_2–UO_2, analysis for boron in uranium-233-enriched, emission spectrographic, 20: 18568(R) (NBL-230)
ThO_2–UO_2, chromatographic analysis for thorium and uranium by hydridation and decomposition, 20: 18577 (TID-22670)
ThO_2–UO_2, properties of powdered, 20: 20365
ThO_2–UO_2, solubility in fluoride–nitric acid solutions, effects of metals and sulfate on, 20: 18819 (AAEC/E-143)
ThO_2–W, development of oxidation-resistant, 20: 19193
THRESHOLD DETECTORS
radiation effects on performance of, bremsstrahlung, 20: 19111 (NP-15910)
THULIUM
separation from americium and curium by electrophoresis in EDTA and *α*-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)

separation from americium and curium by ion exchange in nitrate solutions, 20: 18562(R) (EUR-2640.e)
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599

THULIUM ALLOYS
Ge–Tm, crystal structure of, at or near equiatomic proportions, 20: 19225
Mn–Tm, magnetic structure of intermetallic compound Mn_2Tm in, 20: 18556(R) (BNL-929, pp 66-82)

THULIUM IONS
energy levels of trivalent, (E/T), 20: 19273(R) (BNL-929, pp 3-43)

THULIUM ISOTOPES Tm-165
energy levels from ytterbium-165 decay, (E), 20: 19862

THULIUM ISOTOPES Tm-166
beta decay of, β-γ coincidences in, (E), 20: 19954

THULIUM ISOTOPES Tm-174
decay scheme, (E), 20: 19944

THULIUM ISOTOPES Tm-175
decay scheme, (E), 20: 19944

THULIUM OXIDES
thermal expansion below room temperature, 20: 20168

THULIUM SULFIDES
Cu_2S–Tm_2S_3, phase studies, 20: 18644

THYMIDINE
effects of tritium-labeled, on chromosomes in mice, 20: 18286 (EUR-2462.1)
radiation effects on uptake of tritium-labeled, in normal and tumorous tissue, x, 20: 18271
radiation effects on uptake of tritium-labeled, by DNA in intestine and liver cells, 20: 18278
radiosensitivity effects on tumors, 20: 18464
reactions of tritiated, with desoxyribonucleic acid, 20: 18185(R) (BNL-929, pp 126-47)

THYMIDINE, THYMIDYLYL-
radiation effects on, properties of products formed by uv, 20: 18786

THYMINE
reactions with accelerated atomic hydrogen, 20: 18273

THYMUS GLAND
effects of thymectomy and subsequent implantation of, on urethan-induced leukemogenesis in mice, 20: 18192
effects on immune reactions in mice, 20: 18190(R) (UCRL-16613)
lymphoid tumors in mouse, effects of leukemogenic viruses on, 20: 18193
physiology of, in mice, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiation effects on mouse, γ and proton, 20: 18364
radiation effects on cell reproduction in mouse, survival curve analysis of γ, 20: 18370
radiation effects on nuclear structure of cells of rat, x, 20: 18455
radiosensitivity effects of, in mice, 20: 18286 (EUR-2462.1)
radiosensitivity effects of lyophilized extracts of calf, in rats, 20: 18497
radiotherapy of enlarged, carcinogenesis after childhood x, 20: 18412

THYROID GLAND
iodine-131 content of cattle, environmental monitoring by analysis of, 20: 18971
iodine-131 uptake in human, 20: 20360(R) (PRNC-73)
iodine-131 uptake by computer program for determining normal, 20: 18514
radiation dose to children's, from iodine-131-contaminated milk, 20: 18962
radiation dose to human, after accidental release of iodine-131, 20: 18983
radiography of, multiple-field collimator for, 20: 19052
radiotherapy of cancer of, acute perithyroid edema following γ, 20: 18358
radiotherapy of carcinomas of, scintillation detector for use in, 20: 19084
radiotherapy of carcinomas of, effects on nasal content of iodine-131, 20: 18512
radium-226 content of cattle, effects on iodine-131 determinations, 20: 18971

TIMING CIRCUITS
design for determining radiation detector resolution losses, 20: 19036 (NP-15766)
design for nuclear spectroscopy, 20: 19062

TIN
determination in antimony–tin alloys using beta back scattering, 20: 18587
distribution in deep-sea silts and sea water, 20: 18892 (NYO-3450-1, pp 41-89)
effects on recrystallization of magnesium, 20: 19240
electric conductivity of intermediate state of superconducting, vortex-motion mechanism for, (E), 20: 19743
forces on superconducting films of, in magnetic fields, mechanical, (E), 20: 19765
microwave reflection and transmission coefficients of thin superconducting films of, 20: 19772
properties of, effects of purity on electric and superconducting, 20: 19737
proton reactions at 0.5 to 2 Bev, neutrons from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
tin-119 NMR in monocrystals of, field dependence of Knight shift in, (E), 20: 20155

TIN ALLOYS
Al–Sn–U, fission product distribution in, 20: 19178(R) (IDO-17154)
Al–Sn–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
Bi–Cd–Pb–Sn, preparation of kryptonates of Wood's metal by diffusion, 20: 18570(R) (NYO-2757-5)
In–Sn, indium-115 NMR in liquid, 20: 20157
Mg–Sn, crystallization, 20: 19240
Nb–Sn, preparation of thin films of Nb_3Sn, 20: 19723 (N-65-17508)
Sb–Sn, analysis for antimony, lead, and tin using beta back scattering, 20: 18587
Sb–Sn, magnetic hysteresis loops in superconducting, (E), 20: 19741
Sb–Sn, magnetization of irreversible superconducting, flux gradient instability in, (E), 20: 19745

TIN ISOTOPES
energy levels of odd-mass, shell-model calculation of, 20: 19896
isotopic mixing constants of, volume, (T), 20: 19970
neutron reactions (n,p) at 14 Mev, cross sections for production of isomeric indium isotopes from, (E), 20: 19939

TIN ISOTOPES Sn-114
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

TIN ISOTOPES Sn-116
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

TIN ISOTOPES Sn-119
energy levels of, structure from isomeric transition in, (T), 20: 19970
nuclear magnetic resonance in tin monocrystals, field dependence of Knight shift in, (E), 20: 20155

TIN ISOTOPES Sn-122
energy levels from antimony-122 beta decay, (E), 20: 19960
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

TIN ISOTOPES Sn-124
energy levels of, E1 transition from and lifetime of octupole, (T), 20: 19979

TIN ISOTOPES Sn-125
beta decay of, antimony-125 levels from, (E), 20: 19900

TISSUE CULTURES
growth of lymphoma cells in, effects of nitrogen mustard on, 20: 18462
metabolism in mammalian cells in, tracer study, 20: 18204(R) (LA-3432, pp 130-77)
physiology of mouse thymus-cell, 20: 18509(R) (UCLA-12-576, pp 61-80)
radiation effects on human cancer, cosmic, 20: 18363
radiation effects on proliferative capacity of isolated carrot root cell, 20: 18395
radiation effects on DNA synthesis in human embryonic, x, 20: 18264
radiation effects on DNA synthesis in embryonic mouse, x, 20: 18265
radiation effects on DNA synthesis in HeLa cell, effects of DNA replication on, 20: 18267
radiosensitivity of mammalian-cell, effects of 5-bromodeoxyuridine on uv, 20: 18373
radiosensitivity of embryonic and tumor cell, effects of actinomycin on, 20: 18461
radiosensitivity of cells in, neutron and x, 20: 18548
size distribution in blood-cell, 20: 18297(R) (UCLA-12-576, pp 81-8)

TISSUE HOMOGENATES
effects of leukemogenic, on mice, 20: 18317
effects of spleen, on nitrogen metabolism in γ-irradiated frogs, 20: 18207 (NIJS-R-473)
radiosensitivity effects of mammalian, on Salamander regeneration, x, 20: 18337
radiosensitivity effects of mouse spleen cell, x, 20: 18431
radiosensitivity effects of mouse spleen, x, 20: 18433
radiosensitivity effects of spleen and medullary, on transplanted tumors in mice, 20: 18460
radiosensitivity effects of heterologous spleen, in mice, 20: 18493

TISSUE TRANSPLANTS
radiation effects on Ehrlich's adenocarcinoma, electron and x, 20: 18396
radiation effects on growth of mouse, genetic effects on x, 20: 18304

TISSUES
analysis by activation methods, Szilard-Chalmers effect in, 20: 18583
analysis of subcutaneous ungulate, neutron activation, 20: 18618
content of carbon-14 in body, 20: 18198
effects of radioprotective compounds on, 20: 18475

energy dissipation in, during space flight, 20: 18290(R) (N-65-16483)
plutonium-239 content in lobster, 20: 18227
radiation dosimetry in soft, effects of bone geometry on, 20: 18978
radiation effects on perithyroid, following thyroid cancer radiotherapy, gamma, 20: 18358
radiation effects on, mesons (π^-), 20: 18185(R) (BNL-929, pp 126-47)
radiosensitivity of, effects of chemical compounds on, 20: 18533
radiosensitivity of, effects of anoxia and dose fractionation on, 20: 18548
strontium uptake by plant, factors affecting, 20: 18303
strontium-90 content in mouse, after intraperitoneal or subcutaneous injection, 20: 18225
technetium-99 distribution in rabbit, 20: 18509(R) (UCLA-12-576, pp 61-80)

TITANIUM
determination in uranium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
oxidation by water vapor at 1 and 8 torr, 20: 19197
oxidation films on, structure of, 20: 19188(R) (GEAP-5001)
separation from rare earths by ion exchange chromatography, 20: 18827
surface temperature of, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)

TITANIUM ALLOYS
Mo–Ti–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on TZM, 20: 18567 (MAB-217-M)
Ti–V, development for fuel cladding, 20: 20183

TITANIUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702

TITANIUM ISOTOPES Ti-41
half life, (E), 20: 20365
production and delayed proton emission by, 20: 18556(R) (BNL-929, pp 66-87)

TITANIUM ISOTOPES Ti-43
beta decay of, log ft values for, (T), 20: 19932

TITANIUM ISOTOPES Ti-44
beta decay of, log ft values for, (T), 20: 19932

TITANIUM ISOTOPES Ti-45
beta decay of, log ft values for, (T), 20: 19932
nuclear magnetic dipole moments for, (T), 20: 19932

TITANIUM ISOTOPES Ti-46
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
nuclear magnetic dipole moments for, (T), 20: 19932
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

TITANIUM ISOTOPES Ti-47
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
nuclear magnetic dipole moments for, (T), 20: 19932
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

TITANIUM ISOTOPES Ti-48
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
neutron capture by, nuclear-force time-reversal invariance determination from cascade from polarized thermal, (E), 20: 19906
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

TITANIUM ISOTOPES Ti-49
energy level transitions in, nuclear-force time-reversal invariance determination from, (E), 20: 19906
nuclear magnetic dipole moments for, (T), 20: 19932
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

TITANIUM ISOTOPES Ti-50
alpha inelastic scattering by, level deformation lengths from, (E), 20: 19910
proton reactions (p,n) with, cross sections for, (E), 20: 19838 (UCRL-14760-T)

TITANIUM NITRIDES
structure of, x-ray factors of, 20: 18556(R) (BNL-929, pp 66-82)

TITANIUM OXIDES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
structure of corrosion films of, on titanium, 20: 19188(R) (GEAP-5001)
silicone–TiO_2, radiation effects on, kryptonate method for determining uv, 20: 18570(R) (NYO-2757-5)

TITRATION EQUIPMENT
design of automatic, for plutonium, 20: 18568(R) (NBL-230)

TOBACCO
polonium-210 in cigarette, 20: 18965
radiation effects on growth of seedlings and tissue cultures of, γ, 20: 18383

TOLUENE
radiation effects on carbon tetrachloride polycrystalline solutions of, spectra of resonance charge transfer in, 20: 18752

TOLUENE, CHLORO-
electron capture by, (E/T), 20: 18557 (ORNL-TM-1409)

TOLUENE, NITRO-
electrochemical reduction in organic solvents at 75 to 125°C, rate constants and transfer coefficients for, 20: 18636(R) (TID-22725)

TOLUENE, TRINITRO-
detonation at ground level, precursor shocks from, 20: 18923 (N-65-22654)

TOMATOES
radiation effects on, mutagenic, 20: 18409
radioinduced mutations in pollen of, factors affecting frequency of γ, 20: 18393

TOPOLOGY
universe space-time structure in, complex, 20: 19707

TOXINS
radiosensitivity effects of bacterial, in mice, 20: 18425
radiosensitivity effects of bacterial, in mice, 20: 18496

TRACER TECHNIQUES
for determination of contamination on mass separator collector, 20: 19149
stable isotope uses in, 20: 19120

TRACER TECHNIQUES (AGRICULTURE)
for estimation of plant forage yield, 20: 19119

TRACER TECHNIQUES (BIOLOGY)
erythropoiesis in mice, iron-59, 20: 18304
for glycine conversion to cyanide by chromobacterium, 20: 18185(R) (BNL-929, pp 126-47)
for mechanisms of DNA replication, carbon-14-labeled thymine, 20: 18231
for metabolic studies, assessment of plutonium-237, 20: 18221
for metabolism rate measurement, 20: 18211(R) (UCLA-12-576, pp 89-111)

TRACER TECHNIQUES (BOTANY)
for algal photosynthesis, carbon-14, 20: 18206(R) (N-65-16815)

TRACER TECHNIQUES (MEDICINE)
for carbohydrate metabolism in diabetes, 20: 18185(R) (BNL-929, pp 126-47)
for endocrine function studies, 20: 18530
for fat metabolism, 20: 20360(R) (PRNC-73)
preparation of labeled compounds for, survey of SORIN, 20: 18804 (SORIN-34)
scintillation camera for, 20: 19085
use for diagnosis, 20: 18509(R) (UCLA-12-576, pp 61-80)

TRACER TECHNIQUES (OCEANOGRAPHY)
for distribution of Columbia River sediments on continental shelf, 20: 18902 (RLO-1725-41)
for vertical exchange of strontium-90, 20: 18930
use of carbon-14 content of bicarbonate as tracer for, 20: 18934

TRANSCURIUM ELEMENTS
production and properties, 20: 18649

TRANSDUCERS
design of pressure, for sodium-cooled TREAT loops, 20: 19018(R) (ANL-7110, pp 231-310)

TRANSISTORS
fabrication of p-n junction, using ion implantation technique, 20: 20125
performance in radiation survey meters, 20: 19016 (AD-629709)
radiation effects, 20: 19099(R) (N-65-17954)
radiation effects on 2N918, 20: 19103 (N-65-19758)
radiation effects on capacitance-voltage characteristics of MOS, x, (E), 20: 19113

TRANSITION METAL ALLOYS
Hg–rare earth–transition metal, preparation of rare earth–transition metal alloys by heating, 20: 19185
rare earth–transition metal, preparation from amalgams by heating, 20: 19185

TRANSURANIC ELEMENTS
distribution in nature, 20: 20365
production and properties, 20: 18649
production in epithermal reactors, feasibility of, 20: 20177(R) (BNL-929, pp 83-105)
spectrometry of, mass, 20: 20365

TRAPS
design for fluorinating chemicals, 20: 18824(R) (EURAEC-1536)

TREES
radiation effects on, mutagenic, 20: 18409
radiation effects on, genetic and morphological γ, 20: 18421

TRIISOOCTYLAMINE
solvent properties for americium and rare earths in magnesium chloride solutions, 20: 18562(R) (EUR-2640.e)

TRINEUTRONS
binding energy, (T), 20: 19501

production of, review of attempts at, 20: 19982
TRIOCTYLAMINE
solvent properties for americium, synergism with TTA, 20: 20365
TRIPHENYLENE
effects on radiolytic isomerization of stilbene in benzene solutions, 20: 18735
TRITIUM
content in snow from Antarctica and Mt. Cook in New Zealand, 20: 18909
decay in cyclohexane solutions, yields from internal radiolysis from, 20: 18778
determination in methyl group of organic compounds, 20: 18600
determination in production workers, 20: 18198
diffusion from irradiated lithium chloride, 20: 18763
effects of incorporated, on resistance transfer factor episome in *E. coli*, 20: 18254
effects of thymidine-incorporated, on desoxyribonucleic acid, 20: 18185(R) (BNL-929, pp 126-47)
effects of thymidine-incorporated, on chromosomes in mice, 20: 18286 (EUR-2462.1)
effects on metabolism of yeast, 20: 18372
excretion of estrogen- and ketosteroid-incorporated, in human urine, 20: 18230
gamma reactions (γ,n) with, angular distributions and total cross section for, (E/T), 20: 19868
incorporation in amino acids following radiolysis of ribonuclease, 20: 18749
incorporation in menaquinone and phylloquinone using tritiated water, 20: 18711
incorporation in pyrimidines, 20: 18719
oxygen-16 reactions (O-16,nγ) at 18 Mev, gamma spectra from, (E), 20: 19918
production by neutron reactions (n,α) with lithium-6 in lithium chloride, 20: 18763
radiation effects on uptake of thymidine-incorporated, by DNA in intestine and liver cells, 20: 18278
radiation effects on uptake of thymidine-incorporated, in normal and tumorous tissue, x, 20: 18271
radioinduced gas bubbles of, in aluminum–lithium alloys, behavior of neutron, (E), 20: 19265
reactions of recoil, with benzene, yields of tritiated products from, 20: 18814
separation from hydrogen in evolution on mercury electrode, 20: 18648
TRITIUM IONS
reactions with alkanes, spectral studies on, 20: 18657
reactions with organic compounds at 40 kev, use of isotope separator for study of, 20: 18780
TRITONS
angular distributions from boron-11 (α,t) reactions, (T), 20: 19967
reactions (t,n) with iron-56, cobalt-58 levels from, 20: 20177(R) (BNL-929, pp 83-105)
reactions (t,p) with nuclei, two-nucleon transfer theory for, 20: 19926
TRYPSIN
radioinduced inactivation and ESR spectra of, gamma and uv, 20: 18268
TRYPTOPHAN
radiosensitivity effects on pigments in mouse hair, x, 20: 18502
TUBES
boiling heat transfer in annular, properties of two-phase, 20: 18869(R) (NYO-3114-10)
fluid flow in finite, laminar, 20: 18865 (LA-3418)
heat transfer to near critical water in vertical, (E), 20: 18861 (COO-1177-18)
TUMORS
effects of auxin analogs on, cytotoxic, 20: 18426
effects of plant growth regulators on ascites, 20: 18426
effects of radioprotective compounds on growth of, 20: 18475
growth in bones and hematopoietic tissues, research on, 20: 18198
growth of cultured lymphoma, effects of nitrogen mustard on, 20: 18462
incidence of mouse thymus, effects of leukemogenic viruses on, 20: 18193
induction in hamsters by kidney cells from cultures exposed to adenovirus LLE46, 20: 18197
localization by x-ray scanning, 20: 20360(R) (PRNC-73)
radiation dose to, from injected iodine-131–fibrinogen combined with external x radiation, 20: 18294(R) (TID-22766)
radiation effects on Rous virus-induced, in embryonic membranes, 20: 18321
radiation effects on Ehrlich's adenocarcinoma, electron and x, 20: 18396
radiation effects on pelvic, following ovarian radiocastration, 20: 18397
radiation effects on mouse Ehrlich, effects of adrenal hormones on x, 20: 18437
radiation effects on DNA synthesis in mouse ascites, x, 20: 18266
radiation effects on growth of transplanted mouse, x, 20: 18460
radiodiagnosis of malignant, using inorganic labeled particles, 20: 18529
radioinduced chromosomal aberrations in Ehrlich ascites, x, 20: 18352
radioinduced in man, following childhood therapy, 20: 18412
radioinduced in mice, effects of genetic strain and thymectomy on, 20: 18286 (EUR-2462.1)
radioinduced in rats, effects of parabiosis on x, 20: 18318
radioinduced in rat mammary glands, effects of exposure fractionation and protraction on gamma, 20: 18319
radioinduced in rats, 20: 18188(R) (ORO-635)
radiosensitivity of, effects of drugs on, 20: 18238
radiosensitivity of lymphoma, effects of 5-bromouracil on, 20: 18445
radiosensitivity of hamster melanoma, effects of cyclohexanolsuccinate on, 20: 18463
radiosensitivity of, effects of drugs on, 20: 18464
radiosensitivity of, effects of cortisone on, 20: 18480
radiosensitivity of, effects of chemical compounds on, 20: 18533
radiosensitivity of bronchial, effects of radiomimetic compounds on y, 20: 18534
radiosensitivity of, effects of sodium cyclohexylsuccinate on, 20: 18538
radiosensitivity of stomach, effects of 5-fluorouracil on, 20: 18540
radiosensitivity of lung, effects of actinomycin on, 20: 18541
radiosensitivity of, effects of sodium cyclohexylsuccinate on, 20: 18542
radiotherapy of cervical, complications in combined radium and telecobalt or x, 20: 18309
radiotherapy of cervical, combined radium and x, 20: 18550
radiotherapy of endocrine gland, 20: 18530
radiotherapy of esophageal, effects on lungs of y, 20: 18346
radiotherapy of intravaginal, design and performance of cobalt-60 applicator for, 20: 18511
radiotherapy of malignant, effects on blood vessels in infants, 20: 18398
radiotherapy of malignant, linear programming of dose in, 20: 18524
radiotherapy of oral, late pathological effects, 20: 18523
radiotherapy of plasmocytoma, x, 20: 18551
radiotherapy of pulmonary, drug therapy of inflammation induced by, 20: 18543
radiotherapy of skin, β, 20: 18528
radiotherapy of thyroid, acute edema following gamma, 20: 18358
radiotherapy of thoracic, effects on lungs, 20: 18305
radiotherapy of, dosimetry in electron, y, and x,, 20: 18521
radiotherapy of, effects on erythropoiesis, 20: 18526
radiotherapy of, effects of mitosis-inhibiting drugs on results of, 20: 18537
radiotherapy of, effects of body contours on dosimetry for, 20: 18553
radiotherapy of, late pathological effects on spinal cord, 20: 18406
radiotherapy of, using supervoltage, equipment and methods for rotational, 20: 18423(R) (ACRH-24, pp 125-34)
radiotherapy using high-LET radiations, 20: 18507 (BNL-10009)
radiotherapy using isotopes, 20: 18555
TUNGSTATE IONS
reactions with thorium ions, electrometric studies of, 20: 18650
TUNGSTEN
alpha emission from radon-222 in monocrystalline, 20: 20129
analysis for impurities, comparison of results from 25 laboratories on, 20: 18567 (MAB-217-M)
deposition on uranium carbides by thermochemical decomposition, 20: 19208(R) (N-65-21347)
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
ion reactions at 0.1 to 1.5 Mev, range distributions from, (E), 20: 20135
ion reactions at 200 ev to 4 kev, diffusion of trapped gases following argon, helium, and xenon, 20: 20128
lithium reactions at 20 to 60 kev, secondary electron emission from, (E), 20: 19363
neutron total cross section of, fast, 20: 19805(R) (ANL-7110, pp 1-28)
preparation of single-crystals, 20: 20365
radiation effects on, annealing of neutron, 20: 19267
reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
use of mesh gauge of, for current density measurement in charged-particle beams, 20: 19277
Ta–W, corrosion by molten plutonium alloys, 20: 20239(R) (LA-3482)
TUNGSTEN ALLOY COUPLES
Re–W/W, radiation effects on in-pile thermocouples of, 20: 20185 (CONF-650204-9)
TUNGSTEN ALLOYS
Hf–Ta–W, analysis for alloying elements and impurities, comparison of results from 25 laboratories on T-111, 20: 18567 (MAB-217-M)
Nb–Ta–W–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on FS-85, 20: 18567 (MAB-217-M)
Os–W, thermoelectric properties, 20: 20185 (CONF-650204-9)
Re–W, diffusion in uranium carbide–zirconium carbide, 20: 19211(R)

(N-65-21350)
Re–W, diffusion in uranium carbide–zirconium carbide at 1800°C, 20: 19212(R) (N-65-21351)
Re–W, reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
Ta–Th–W, development of oxidation-resistant, 20: 19193
Ta–W, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Ta–W, reactions with combustion gas species in launch pad abort environments, 20: 19192 (SC-DR-65-1918)
Tc–W, thermoelectric properties, 20: 20185 (CONF-650204-9)
TUNGSTEN BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702
TUNGSTEN COUPLES
Re–W/W, radiation effects on in-pile thermocouples of, 20: 20185 (CONF-650204-9)
TUNGSTEN ISOTOPES
separation and preparation of targets at ORNL calutron, 20: 19153
TUNGSTEN ISOTOPES W-172
energy levels of, high-spin rotational, (E/T), 20: 19953
TUNGSTEN ISOTOPES W-174
energy levels of, high-spin rotational, (E/T), 20: 19953
TUNGSTEN ISOTOPES W-176
energy levels of, high-spin rotational, (E/T), 20: 19953
TUNGSTEN ISOTOPES W-182
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
nuclear data, 20: 19879
TUNGSTEN ISOTOPES W-183
nuclear data, 20: 19880
TUNGSTEN ISOTOPES W-184
nuclear data, 20: 19881
TUNGSTEN ISOTOPES W-185
nuclear data, 20: 19882
TUNGSTEN ISOTOPES W-186
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
TUNGSTEN SYSTEMS
development of composites of, containing fibered or reacted additives, 20: 19179 (N-65-21643)
Al_2O_3–W, development of oxidation-resistant, 20: 19193
Co–WC, microstructure, 20: 19236
Co–WC, sample preparation for electron microscope examination of, 20: 19236
MgO–W, development of oxidation-resistant, 20: 19193
Ta–ThO_2–W, development of oxidation-resistant, 20: 19193
Ta–ThO_2–W–Zr, development of oxidation-resistant, 20: 19193
ThO_2–W, development of oxidation-resistant, 20: 19193
W–UO_2, chromatographic analysis for uranium by hydridation and decomposition, 20: 18577 (TID-22670)
TURBINE BLADES
surface temperature measurements on, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
TURBINES
development of gas, 20: 20183
development of potassium-driven, for space power plants, 20: 18881(R) (N-65-18742)
instrumentation for power reactor, review of, 20: 20246 (RISO-M-312)
TURKEY
Cekmece Nuclear Research and Training Center, BNL cooperation with, 20: 20343
food grain radiosterilization in, pilot plant for, 20: 19125
radiation facility for grain disinfestation in, 20: 19123
TURTLES
radiation effects on mitosis in, gamma, 20: 18291(R) (N-65-17058)
TYROSINE
radiosensitivity effects on pigments in mouse hair, x, 20: 18502

U

ULTRASONICS
effects on phosphorus absorption by rat intestine, 20: 18219
ULTRAVIOLET RADIATION
effects of, combined with solar radiation on Xanthium leaves, 20: 18391
effects on activity and ESR spectra of trypsin, 20: 18268
effects on bacteria during transformation, 20: 18320
effects on biological functions of transfer RNA, 20: 18249
effects on collagen macromolecules, 20: 18252
effects on colorless and pigmented bacteria, lethal, 20: 18361
effects on composition and function of carboxypeptidase, 20: 18250
effects on decomposition of deuterium mixtures with ethylene and silane, mercury sensitization effects on, 20: 18729(R) (NYO-2007-9)
effects on defects in potassium chlorate monocrystals, 20: 20117
effects on diploid and haploid Saccharomyces, biological, 20: 18405
effects on *E. coli*, photoreactivation of, 20: 18315
effects on *E. coli* replication of RNA phages, 20: 18316
effects on ESR spectra of albumin and methionine, 20: 18791
effects on fluorescence of terbium chelate systems in light and heavy water, 20: 18683
effects on green colony-forming ability in Euglena, photoreactivation of, 20: 18253
effects on lactate dehydrogenase activity, 20: 18451
effects on maize endosperm, mutagenic, 20: 18392
effects on maize, genetic, 20: 18334
effects on mammalian cells in culture, effects of 5-bromodeoxyuridine on, 20: 18373
effects on microorganisms, use in size estimations, 20: 18314
effects on Neurospora, utilization of mutagenic, 20: 18347
effects on Neurospora, mutagenic, 20: 18196
effects on photosynthesis, 20: 18365
effects on plant leaves, photoreactivation of, 20: 18391
effects on silicone–titanium dioxide coatings, kryptonate method for determining, 20: 18570(R) (NYO-2757-5)
effects on structure of carboxypeptidase, 20: 18251
effects on thymidylylthymidine, properties of products formed by, 20: 18786
effects on volatile hydride formation in germane and silane systems, mercury sensitization effects on, 20: 18729(R) (NYO-2007-9)
effects on yeast, genetic, 20: 18190(R) (UCRL-16613)
effects on yellowing of wool, tracer studies on role of amino acid decomposition in, 20: 18281
intensity in ionosphere, sunspot activity correlations with, 20: 19647
monochromator design for high-intensity, 20: 19011
ULTRAVIOLET SOURCES
design of extreme, 20: 19032(R) (N-65-23928)
ULTRAVIOLET SPECTRA
analysis of, computer, 20: 18205(R) (LA-3432, pp 178-262)
UNDERGROUND EXPLOSIONS
data on U. S., Oct. 1965, 20: 18972
data on, announced June 1965, 20: 18914
data on, announced July 1965, 20: 18915
data on, announced Nov. 1965, 20: 18918
fallout from Soviet vented, highly fractionated nuclides in, 20: 18913
seismic data on Soviet, Oct. 1965, 20: 18972
shock effects of Hardhat, on mechanical and optical properties of granodiorite, 20: 18856
UNION CARBIDE NUCLEAR CO., PADUCAH PLANT, KY.
environs monitoring, 1964, 20: 18914
UNION CARBIDE NUCLEAR CO. Y-12 PLANT, OAK RIDGE, TENN.
environs monitoring, 1964, 20: 18914
UNION OF SOUTH AFRICA
waste disposal in, low- and intermediate-level, 20: 20352
UNITED KINGDOM
strontium-90 content of bone samples in, 20: 18922
UNITED STATES
fallout monitoring programs, 1963 to 1965, 20: 18980
geology and mineralogy in western, 20: 18924(R) (NYO-1669-11)
radioactivity in diet in, 1961 through 1964, 20: 18920
URACIL
labeling with tritium, 20: 18719
URACIL, 5-BROMO-
incorporation into DNA of mutants of lymphoma cells, 20: 18445
radiosensitivity effects on *Escherichia coli*, y, 20: 18295(R) (UCLA-12-576, pp 27-56)
radiosensitivity effects on animal cells, 20: 18444
radiosensitivity effects in lymphoma cells, 20: 18445
URACIL, 5-FLUORO-
radiosensitivity effects on tumors, 20: 18464
radiosensitivity effects on lung carcinomas, 20: 18539
radiosensitivity effects on stomach cancer, 20: 18540
URANIUM
analysis for impurities by carrier distillation, spectrographic, 20: 18563 (EUR-2647.f)
content in Azov Sea, 20: 18905
content in carbonatites, age estimation from, 20: 18924(R) (NYO-1669-11)
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
content in zircons, age estimations from, 20: 18924(R) (NYO-1669-11)
cost factors for enriched, computer program for calculating, 20: 18822 (BNWL-189)
creep properties of, effects of dynamic and static heat treatments on, 20: 19246
density measurements of, liquid media for, 20: 19219 (RFP-691)
determination following solvent extraction using mesityl oxide, colorimetric, 20: 18605
determination for nuclear materials management, review of analytical methods for, 20: 18619

determination in aluminum–uranium alloys by gamma absorption, 20: 18603
determination in aluminum–uranium alloys, comparison of methods for, 20: 18604
determination in bicarbonate solutions, polarographic, 20: 18612
determination in plutonium and uranium dioxides and plutonium–uranium monocarbide fuels, methods for, 20: 18578 (TRG-Report-1165)
determination in solutions by alpha spectrometry and isotope dilution, 20: 18568(R) (NBL-230)
determination in thorium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
determination of, evaluation of methods for, 20: 18568(R) (NBL-230)
determination of, using triphenylarsine oxide, 20: 18607
diffusion in gamma-phase, effects of cobalt additions on self-, 20: 19175 (ANL-6568)
diffusion of chromium, cobalt, copper, iron, manganese, nickel, and niobium in gamma-phase, 20: 19175 (ANL-6568)
diffusion of oxygen in, effects of crystal structure and temperature on, 20: 19234
diffusion of plutonium in grain boundaries of alpha-phase, during grain growth, 20: 19235
distribution in aqueous carboxylic acid–TBP, effects of hydrogen bonding on, 20: 18845
effects of inhaled, on animals and man, 20: 18198
electron beam scattering by thick targets of, retrofugal flux from, (E), 20: 19394
electron scattering at 1 to 10 Mev by thick targets of, energy spectra of retrofugal flux from, (E), 20: 19395
neutron cross sections in crystals of uranium dioxide, chemical binding effects on, 20: 20201(R) (ANL-7110, pp 311-401)
neutron fission at 14 Mev, alpha and fission-fragment angular distributions from, (E), 20: 19861
neutron total cross section of, fast, 20: 19805(R) (ANL-7110, pp 1-28)
preparation of thick and thin sources of, by electroplating and electrophoresis, 20: 18562(R) (EUR-2640.e)
proton elastic scattering at 20 Bev, cross sections for, (E), 20: 19901
proton reactions at 2.9 to 28 Bev, yields from, 20: 18556(R) (BNL-929, pp 66-82)
proton reactions at 0.5 to 2 Bev, neutrons from, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
radioinduced swelling in, 20: 20365
sample preparation of, procedures and standards for metallographic, 20: 19180 (NLCO-954)
separation from ceramic fuels by fluid-bed volatility process, computer program for use with, 20: 18820 (ANL-6992)
separation from fission products and plutonium in reactor fuels by fluid-bed fluoride volatility process, 20: 18821 (ANL-7077)
separation from fission products using focusing chromatography, 20: 18601
separation from leach solutions by solvent extraction using amines, mobile installation for, 20: 18836
separation from nitric acid solutions by solvent extraction using tridecylmethylammonium nitrate, 20: 18839
separation from nitric acid solution, by solvent extraction using mesityl oxide, 20: 18605
separation from rare earths by ion exchange chromatography, 20: 18827
separation from rare earths and thorium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
separation from residues by ion exchange and TBP extraction, 20: 18568(R) (NBL-230)
spectra of trivalent, in lithium bromide, lithium chloride, and sulfuric acid solutions, 20: 18653
structure of alpha-phase, 20: 20365
thermodynamic properties of gaseous, at 298 to 20,000°K, 20: 18637(T) (KFK-tr-177)
thermodynamic properties at high temperatures and pressures, 20: 19217 (NP-15933)

URANIUM ALLOYS
analysis for tantalum, spectrophotometric, 20: 18565 (LA-3465)
analysis for uranium for nuclear materials management, review of methods for, 20: 18619
sample preparation of, procedures and standards for metallographic, 20: 19180 (NLCO-954)
Al–Al_4U, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–Sn–U, fission product distribution in, 20: 19178(R) (IDO-17154)
Al–Sn–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
Al–U, analysis for uranium by gamma absorption, 20: 18603
Al–U, analysis for uranium, comparison of methods for, 20: 18604
Al–U, production of intermetallic compounds of, for use as reactor fuels, 20: 19178(R) (IDO-17154)
Al–U, reactions of UAl_3 in, with aluminum at 600°C, 20: 19178(R) (IDO-17154)
fission–Pu–U, compatibility with cladding materials, 20: 20183

URANIUM CARBIDES
coating with tungsten by thermochemical decomposition, 20: 19208(R) (N-65-21347)
corrosion during fuel can rupture, 20: 19184
development of tungsten-clad, as cathodes for thermionic space reactors, 20: 19207(R) (N-65-21346)
diffusion of uranium in, self-, 20: 19184
emission and vaporization testing of tungsten-clad, in cesium vapor, 20: 19208(R) (N-65-21347)
fabrication of 5% enriched fuel rods of, safety criteria for, 20: 20228 (Al-Memo-8810(Rev.1))
free energy of formation, 20: 20177(R) (BNL-929, pp 83-105)
preparation of bars of, 20: 19262
radiation effects on pellets of, 20: 20177(R) (BNL-929, pp 83-105)
radiation effects on structure of, in-pile, 20: 19262
radiation effects on krypton trapping on surfaces of, thermal-neutron, 20: 19255 (EUR-2749.e)
reactions with carbon dioxide and water at high temperatures, 20: 18824(R) (EURAEC-1536)
reactions with chlorine trifluoride, 20: 18824(R) (EURAEC-1536)
NbC–UC, vacuum emission of, 20: 19211(R) (N-65-21350)
PuC–UC, compatibility with cladding materials, 20: 19183
PuC–UC, radioinduced swelling in mixed, 20: 19183
PuC–UC, uses as fuel for fast reactors, 20: 19183
Pu–UC, analysis for plutonium and uranium, methods for, 20: 18578 (TRG-Report-1165)
TaC–UC, evaporation of, rate of vacuum, 20: 19212(R) (N-65-21351)
UC–ZrC, development as cathodes for thermionic space reactors, 20: 19207(R) (N-65-21346)
UC–ZrC, diffusion of iridium, rhenium, and rhenium–tungsten alloy in, 20: 19211(R) (N-65-21350)
UC–ZrC, diffusion of iridium, rhenium, and rhenium–tungsten alloy in, at 1800°C, 20: 19212(R) (N-65-21351)
UC–ZrC, emission and vaporization testing of, in cesium vapor, 20: 19208(R) (N-65-21347)
UC–ZrC, vacuum emission of thermionic cell cathodes of, 20: 19208(R) (N-65-21348)
UC–ZrC, vaporization testing in cesium vapor, 20: 19210(R) (N-65-21349)
UC–ZrC, vaporization testing of, in cesium vapor, 20: 19211(R) (N-65-21350)
UC–ZrC, vaporization of, effects of cesium vapor pressure and sample density on rate of, 20: 19212(R) (N-65-21351)
U–UC, phase studies, 20: 19184

URANIUM(IV) CHLORIDES
reactions with ammonia in ionic melts, precipitation of uranium nitrides by, at 700 to 1200°C, 20: 18698

URANIUM COMPLEXES
with amines, thermodynamic properties of nitrate, 20: 18829
with TTA, preparation and properties of single-crystal, 20: 18682

URANIUM COMPOUNDS
analysis for uranium for nuclear materials management, review of methods for, 20: 18619
use as pigments for ceramic glazes, 20: 18974

URANIUM CONCENTRATES
analysis for uranium for nuclear materials management, review of methods for, 20: 18619

URANIUM FLUORIDES
conversion to oxides in fused salts, 20: 18824(R) (EURAEC-1536)

URANIUM(III) FLUORIDES
free energy of formation, 20: 20177(R) (BNL-929, pp 83-105)

URANIUM(IV) FLUORIDES
production by thermal decomposition of hydrazine heptafluorouranate(V), 20: 18627 (NIJS-R-459)
separation from air streams, methods for, 20: 18824(R) (EURAEC-1536)
sorption by sodium fluorides, 20: 18824(R) (EURAEC-1536)

URANIUM(VI) FLUORIDES
diffusion of, coefficient for self-, 20: 19242
fluorine nuclear magnetic resonance spectra in, anisotropy of chemical shift of, 20: 18706
reactions with hydrazine difluoride, formation of hydrazine hepta-fluorouranate(V) in, 20: 18628 (NIJS-R-460)
uses in production of uranium dioxide, equipment for, 20: 18707(P)

URANIUM(IV) IODIDES
reactions with iodine at 200, 300, and 400°C, 20: 18640
reactions with oxygen at 200, 300, and 400°C, 20: 18640

URANIUM IONS
complexes between oxygenated, 20: 20365
oxidation of tetravalent, by iron(III) ions in sulfuric acid solutions, effects of temperature on, 20: 18693
thermodynamic properties of gaseous, at 298 to 20,000°K, 20: 18637(T)

URANIUM ISOTOPES

determination of, mass spectrometric procedure for, 20: 18568(R) (NBL-230)
separation and processing using ORNL calutrons, 20: 19165
separation of, computer program for calculating cost factors for, 20: 18822 (BNWL-189)

URANIUM ISOTOPES U-230
alpha spectra, (E), 20: 19857

URANIUM ISOTOPES U-232
energy levels of, high-spin rotational, (E/T), 20: 19953
production by irradiation of protactinium-231, 20: 18802 (CEA-R-2917)
purification and uses of, 20: 18802 (CEA-R-2917)

URANIUM ISOTOPES U-233
neutron scattering amplitudes of, coherent, (T), 20: 19845
production in thorium–uranium fuels, 20: 20183
separation from irradiated thorium dioxide or metal, mixer-settler performance in Thorex Process for, 20: 18823 (DP-1022)

URANIUM ISOTOPES U-234
content in mollusks from raised marine terraces, age estimation from, 20: 18925 (NYO-3450-1, pp 1-27)
energy levels of, high-spin rotational, (E/T), 20: 19953

URANIUM ISOTOPES U-235
fission yields from, (E), 20: 20365
neutron cross sections, 20: 19844 (WANL-TME-1228)
neutron elastic scattering at 0.4 to 9.6 Mev, cross sections for, (E), 20: 19935
neutron fission at 0.36 to 0.65 Mev, cross section for, (E), 20: 19935
neutron fission of, fast, (E), 20: 19805(R) (ANL-7110, pp 1-28)
neutron fission of, silicon detectors for measurement of fragment energy from thermal, 20: 19070
neutron fission rate of, measurement of, 20: 19018(R) (ANL-7110, pp 231-310)
neutron scattering amplitudes of, coherent, (T), 20: 19845
neutron total cross section of, fast, 20: 19805(R) (ANL-7110, pp 1-28)
H–^{235}U, distribution ratio in vortex flow, 20: 20293 (JPL-TR-32-808)

URANIUM ISOTOPES U-238
bremsstrahlung reactions at 5.2 to 9.25 Mev, fission product angular distributions from, (E), 20: 19830 (NP-15055)
content in mollusks from raised marine terraces, 20: 18925 (NYO-3450-1, pp 1-27)
energy levels of, high-spin rotational, (E/T), 20: 19953
evolution with lead in Earth's crust, 20: 18894 (NYO-3450-1, pp 169-84)
fission yields from, (E), 20: 20365
gamma reactions at 6.1 to 7.1 Mev, fission product angular distributions from, (E), 20: 19830 (NP-15055)
neutron capture rate in, measurement of, 20: 19018(R) (ANL-7110, pp 231-310)
neutron cross sections, 20: 19844 (WANL-TME-1228)
use in fuel elements for pressurized boiling light water reactor, 20: 20223(P)

URANIUM LEACH SOLUTIONS
separation of uranium from, by solvent extraction, mobile installation for, 20: 18836

URANIUM NITRIDES
compatibility with potential cladding metals, 20: 19187 (BMI-1760)
precipitation by reactions of ammonia with uranium tetrachloride solutions in ionic melts at 700 to 1200°C, 20: 18698
Al–UN, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
UN–UO_2, phase studies, 20: 19184

URANIUM ORES
analysis for uranium for nuclear materials management, review of methods for, 20: 18619

URANIUM OXIDES
deposition on metals by electrolysis, effects of electrolyte on, 20: 18691
phase diagram, 20: 19184
preparation and semiconducting properties of $UO_{2.04}$ to $UO_{2.60}$, 20: 18675

URANIUM(IV) OXIDES
analysis for boron, methods evaluation for, 20: 19253(R) (CEND-3107-261)
analysis for lanthanum, niobium, thorium, titanium, yttrium, and zirconium, x-ray spectrographic, 20: 18558 (AECL-2526)
analysis for plutonium and uranium, methods for, 20: 18578 (TRG-Report-1165)
analysis for uranium by hydridation and decomposition, chromatographic, 20: 18577 (TID-22670)
composition of, defect theory of nonstoichiometric, 20: 18666
crystal and magnetic structure of, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
determination in sintered thorium dioxide–uranium dioxide, tungsten–uranium dioxide, and uranium dioxide, method for, 20: 18577 (TID-22670)
diffusion of oxygen in single-crystal, self-, 20: 19188(R) (GEAP-5001)
diffusion of uranium in, self-, 20: 19184
fission gas diffusion and temperature distribution during irradiation in sintered, 20: 19182
fission gas diffusion from, review of mechanisms of, 20: 19184
preparation and sintering of powders of, industrial-scale, 20: 19182
preparation of single-crystals, 20: 20365
production by electrodeposition from fused salts, 20: 18824(R) (EURAEC-1536)
production from uranium hexafluoride, equipment for, 20: 18707(P)
radiation effects on boron-bearing fuel elements of, 20: 19253(R) (CEND-3107-261)
reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
reactions with zirconia, effects of temperature on, 20: 20365
thermal properties of, effects on kinetics of fast reactors, 20: 20201(R) (ANL-7110, pp 311-401)
thickness measurements of thin films of, nondestructive, 20: 19025 (EIR-86)
xenon-133 ranges in, 20: 20136
Al–BeO–UO_2, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–UO_2, fission product distribution in dispersion fuels of, 20: 19178(R) (IDO-17154)
Fe–UO_2, radiation effects on pellets of, 20: 20177(R) (BNL-929, pp 83-105)
PuO_2–UO_2, conversion to fluorides by reaction with chlorine trifluoride and hydrogen fluoride, 20: 18824(R) (EURAEC-1536)
PuO_2–UO_2, neutron buckling in graphite lattices fueled by, (T), 20: 20199 (AEEW-R-466)
PuO_2–UO_2, neutron buckling in graphite lattices fueled by, (E), 20: 20198 (AEEW-R-464)
PuO_2–UO_2, neutron Doppler measurements in ZEBRA core 5, 20: 20310 (AEEW-R-465)
PuO_2–UO_2, radiation effects on microstructure of, in-pile, 20: 19257 (TID-22716)
ThO_2–UO_2, analysis for boron in uranium-233-enriched, emission spectrographic, 20: 18568(R) (NBL-230)
ThO_2–UO_2, chromatographic analysis for thorium and uranium by hydridation and decomposition, 20: 18577 (TID-22670)
ThO_2–UO_2, properties of powdered, 20: 20365
ThO_2–UO_2, solubility in fluoride–nitric acid solutions, effects of metals and sulfate on, 20: 18819 (AAEC/E-143)
UN–UO_2, phase studies, 20: 19184
W–UO_2, chromatographic analysis for uranium by hydridation and decomposition, 20: 18577 (TID-22670)

URANIUM(IV-VI) OXIDES
fluorination of, fluidized-bed method for, 20: 18821 (ANL-7077)
reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
reduction by hydrogen, formation of semiconducting phases in, 20: 18675
Al–B_4C–U_3O_8, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)
Al–U_3O_8, radioinduced swelling in dispersion fuels of, neutron, 20: 19178(R) (IDO-17154)

URANIUM SYSTEMS
sample preparation of, procedures and standards for metallographic, 20: 19180 (NLCO-954)
Al–Si–U, reactions with aluminum at 600°C, 20: 19178(R) (IDO-17154)
fiberglass–U, development of MTR-type fuel elements of, 20: 19178(R) (IDO-17154)
U–UC, phase studies, 20: 19184

URANYL BROMIDE COMPLEXES
with tributylphosphine oxide, preparation of, 20: 18646

URANYL CHLORIDE COMPLEXES
with pyridine-*N*-oxides, preparation, infrared spectra, and magnetic susceptibility, 20: 18684
with tributylphosphine oxide, preparation of, 20: 18646
with urea and alkyl derivatives of urea, preparation and properties of, 20: 18694

URANYL FLUORIDE COMPLEXES
with tributylphosphine oxide, preparation of, 20: 18646

URANYL IODIDE COMPLEXES
with tributylphosphine oxide, preparation of, 20: 18646

URANYL NITRATE COMPLEXES
with urea and alkyl derivatives of urea, preparation and properties of, 20: 18694

URANYL NITRATES
sorption by glass surfaces, 20: 18846
thermal decomposition of hexahydrate of, at 250 to 400°C, 20: 18655
$CsNO_3$–$UO_2(NO_3)_2$–H_2O, thermodynamic properties of compound formation in, at 25°C, 20: 18696
dodecane–HNO_3–TBP–$UO_2(NO_3)_2$–H_2O, equilibrium relations for, for nitric acid-uranyl nitrate extraction, 20: 18844

URANYL OXALATES
complexes with urea and alkyl derivatives of urea, preparation and

properties of, 20: 18694
URANYL PERCHLORATES
complexes with urea and alkyl derivatives of urea, preparation and properties of, 20: 18694
URANYL SULFATE COMPLEXES
with urea and alkyl derivatives of urea, preparation and properties of, 20: 18694
UREA COMPLEXES
with thorium bromides, chlorides, and iodides, properties of, 20: 18647
with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, 1,3-DIETHYL-
complexes with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, 1,3-DIMETHYL-
complexes with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, ETHYL-
complexes with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, METHYL-
complexes with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, TETRAMETHYL-
complexes with uranyl chloride, nitrate, oxalate, perchlorate, and sulfate, preparation and properties of, 20: 18694
UREA, THIO-
radiosensitivity effects on yeast, 20: 18503 (AD-611869, pp 169-83)
URETHAN POLYMERS
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
URIDINE, 5-BROMO-2'-DEOXY-
radiosensitivity effects on mammalian cells in culture, uv, 20: 18373
radiosensitivity effects in mice, x, 20: 18498
radiosensitivity effects of, combined with MEA in mice, x, 20: 18498
radiosensitizing effects on resistance transfer factor in *E. coli*, 20: 18254
URINARY TRACT
radiation effects on, following radium therapy of cervical cancer combined with telecobalt or x rays, 20: 18309
URINE
analysis for thorium, method for, 20: 18805 (SZS-12(1965))
barium-133 clearance from human, 20: 18226
calcium-47 clearance from human, 20: 18226
cesium-137 content in human, contribution of milk to, 20: 18220
content of tritium-labeled estrogens and ketosteroids in human, after labeled testosterone injections, 20: 18230
erythropoietin content in, effects of anemia on, 20: 18190 (UCRL-16613)
radiation effects on DNAase activity in rat, neutron, 20: 18262
radium-223 clearance from human, 20: 18226
strontium excretion in, chelates for promoting, 20: 18209 (TID-22717)
strontium-85 clearance from human, 20: 18226
URONIC ACIDS
radioinduced demethylation of papaya, gamma, 20: 18246(R) (UH-235P5-1, pp 7-13)
UTERUS
radiation effects on cervical carcinoma cells in, gamma, 20: 18330
radiation exposure method for one horn of, in pregnant mice, 20: 18404
radiotherapy of carcinomas of, 20: 20360(R) (PRNC-73)
radiotherapy of carcinomas of, effects on vaginal cells, 20: 18331
radiotherapy of cancer of, complications in combined radium and telecobalt or x, 20: 18309
radiotherapy of cancer of, combined radium and x, 20: 18550

V

VACCINES
immunogenic activity of, prepared from γ-irradiated *Brucella melitensis*, 20: 18509(R) (UCLA-12-576, pp 61-80)
VACUUM PUMPS
performance of adsorption, 20: 18889 (LNF-65/38)
VACUUM SYSTEMS
description of continuous thin film deposition, 20: 19201
development of ultrahigh, using unbaked apparatus with rubber packing, 20: 18890
performance of AGS, 20: 19285(R) (BNL-929, pp 44-57)
VAGINA
radiation effects on cells of, following cervical carcinoma therapy, 20: 18331
radiotherapy of cancer of, design and performance of cobalt-60 applicator for, 20: 18511
VALINE
labeling with tritium following radiolysis of ribonuclease, 20: 18749
VALVES
design of large sodium, conceptual, 20: 20184 (ACNP-65579)
VAN ALLEN RADIATION BELTS
electron density diurnal variation in outer, geomagnetic activity correlations with, (E), 20: 19682
properties and structure of, review of, 20: 19697
properties of, review of, 20: 19645 (NASA-SP-97)
VAN DE GRAAFF ACCELERATORS
beam energy calibration of Dacca, 20: 19284 (AECD-EP-8)
beam ionization stages, spectral method for determining, 20: 19402
beam stabilization system for 2-Mev, design of fast, 20: 19295 (CERN-66-11)
control using on-line computer, 20: 19018(R) (ANL-7110, pp 231-310)
design with inclined electrodes, 20: 19315
target cooling system for, 20: 18877
VANADATES
determination of, using triphenylarsine oxide, 20: 18607
VANADIUM
oxidation by water vapor at 1 and 8 torr, 20: 19197
preparation of purified, 20: 20365
superconducting transition temperature of, pressure dependence of, (E), 20: 19762
VANADIUM ALLOYS
Mo–Nb–V–Zr, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Nb–V–Zr, development and properties of niobium-base Cb-753, 20: 19214 (N-65-22097)
Ti–V, development for fuel cladding, 20: 20183
VANADIUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702
VANADIUM HYDRIDES
neutron inelastic scattering by, determination of localized modes of hydrogen excess in, (E), 20: 20107 (EUR-2734.e)
VANADIUM ISOTOPES V-47
beta decay of, log ft values for, (T), 20: 19932
VANADIUM ISOTOPES V-49
beta decay of, log ft values for, (T), 20: 19932
VANADIUM ISOTOPES V-51
neutron capture at 14 Mev, gamma spectra from, (E), 20: 19829 (NIJS-R-455)
neutron reactions (n,γ) with, vanadium-52 level scheme from thermal, (E), 20: 19899
proton reactions (p,γ) at 0.6 to 2.7 Mev, isobaric analog resonances in chromium-52 from, 20: 19928
VANADIUM ISOTOPES V-52
energy-level scheme from thermal neutron reactions (n,γ) with vanadium-51, (E), 20: 19899
VANADIUM SILICIDES
electron-spin pairing in single crystals of superconducting, neutron-diffraction studies of, 20: 20152
magnetization measurements in, 20: 20109(R) (MIT-3031-3)
polarization in superconducting, electronic and nuclear, 20: 20109(R) (MIT-3031-3)
VELOCITY
effects of, combined with x radiation on mitosis in mouse marrow, 20: 18439
VIBRATIONS
effects of high-frequency and ultrasonic, on radiophosphorus absorption in dog intestine, 20: 18219
effects of, combined with γ radiation on phage production in *E. coli*, 20: 18363
effects of, combined with x radiation on mitosis in mouse marrow, 20: 18439
effects of, combined with proton-irradiation on shielded rats, 20: 18441
effects on phage production in *E. coli*, 20: 18363
VIRGINIA
simulated extraterrestrial environments in, Gulliver III tests on, 20: 18187(R) (N-65-16497)
VIRUSES
desoxyribonucleic acid induction by Polyoma, in x-irradiated mouse and rat embryo cell cultures, 20: 18369
effects of leukemogenic, on tumorigenesis in mouse thymus, 20: 18193
effects on hamster kidney-cell cultures, neoplastic, 20: 18197
isolation from animal and human tissue, summary of data on, 20: 20360(R) (PRNC-73)
photoreactivation of plant, effects of morphology on, 20: 18360
photosensitivity of, effects of furocoumarins on, 20: 18469
radiation effects on dengue, gamma and x, 20: 20360(R) (PRNC-73)
radiation effects on Puerto Rican animal, 20: 20360(R) (PRNC-73)
radiation effects on reproductive capacity of Rous, 20: 18321
VITAMIN B
radiosensitivity effects on rat leukocytes, beta, 20: 18499
VITAMIN B_{12}
determination in human liver of cobalt-57-labeled, collimator for,

20: 19051
VITAMIN C
radiation effects on papaya content, 20: 18248(R) (UH-235P5-1, pp 52-4)
VITAMIN K
labeling with tritium, 20: 18711
VOLATILITY SEPARATION PROCESSES
development for ceramic fuels and fuel alloys, 20: 20177(R) (BNL-929, pp 83-105)
development for spent fuels, 20: 20183
VOLTAGE REGULATORS
design for accelerators, 20: 19323(P)
VOLUMETRIC ANALYSIS
equipment and method for particle, for biological applications, 20: 18186(R) (LA-3432, pp 102-29)

W

WASTE DISPOSAL
development in, at Pelindaba, South Africa, 20: 20352
fixation in glass, computer program for glass composition for, 20: 20346 (ORNL-3824)
ground, in United Arab Republic, 20: 20350
methods development at BNL, 20: 20177(R) (BNL-929, pp 83-105)
storage in salt mines, design and operation of Project Salt Vault for, 20: 20347 (ORNL-P-2058)
storage in stainless steel leak-tight containers, design of packaging facilities for, 20: 20348 (RL-SA-60)
WASTE PROCESSING
calcination, pilot plant studies on pot and spray, 20: 20345 (BNWL-SA-569)
development in, at Pelindaba, South Africa, 20: 20352
evaporation and denitration of Purex solutions, performance of equipment for, 20: 20344 (BNL-10047)
precipitation-ion exchange, economics of plant using, 20: 20349
techniques for liquid and solid, in India, 20: 20351
WASTE SOLUTIONS
analysis for uranium for nuclear materials management, review of methods for, 20: 18619
decontamination by contact precipitation and ion exchange, 20: 20349
WATER
analysis of, infrared absorption equipment for isotopic, 20: 18620(P)
content in concretes, thermal neutron scattering determination of, 20: 18610
corrosive effects on aluminum–beryllium alloys at 163°C, 20: 19178(R) (IDO-17154)
corrosive effects on welded joints of niobium–zirconium alloys, 20: 19195
critical solution temperatures of phenols in, 20: 18720
determination in organic liquids using kryptonates, sensitivity of, 20: 18570(R) (NYO-2757-5)
determination in soils by neutron energy losses, 20: 19118
effects on active transport of arabinose, glucose, and sodium in hamster intestine, 20: 18212
effects on atomic hydrogen yields from low-pressure hydrogen discharge, 20: 18663
effects on electrochemical reduction of aliphatic nitro compounds, 20: 18636(R) (TID-22725)
effects on oxygen effect in irradiated barley seed, 20: 18389
effects on radioinduced fluorescence in terbium chelate systems in, 20: 18683
effects on radiosensitivity of artemia eggs, 20: 18342
effects on yields from gamma radiolysis of acetone, 20: 18737
electron capture by, (E/T), 20: 18557 (ORNL-TM-1409)
heat transfer in sub- and supercritical, 20: 18862 (COO-1177-19)
heat transfer to near critical, in vertical tubes, (E), 20: 18861 (COO-1177-18)
neutron scattering by, thermal, (T), 20: 19781 (JAERI-1095)
neutron spectra in, temperature dependent, 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
properties for polarographic reduction of organic compounds, 20: 18636(R) (TID-22725)
radiation chemistry of, under alpha bombardment at 30 Mev, 20: 18809
radiation chemistry of liquid and frozen, 20: 18190(R) (UCRL-16613)
radiation effects on content in muscle, γ and x, 20: 18293 (NP-14898)
radiolysis of acid solutions of, yields of products of, 20: 18745
radiosensitivity effects on grass seeds, 20: 18382
radiosensitivity effects on mutation frequency in tomato pollen, γ, 20: 18393
radiosensitivity effects on Pisum meal, 20: 18429
reactions with radioisotope-containment materials in launch pad abort environments, 20: 19192 (SC-DC-65-1918)
reactions with uranium carbides at high temperatures, 20: 18824(R) (EURAEC-1536)
separation from anisole, methods for, 20: 19135(R) (K-C-718)
separation from steam, performance of radial-vane separator for, 20: 18864 (GEAP-4935)
solvent properties for benzenesulfonic acid, isotope effects on, 20: 18643
uptake by wheat, effects of thermal treatment on, 20: 18323
air–H_2O, flow in vertical tubes, pressure drop and void fractions for, 20: 18869(R) (NYO-3114-10)
carboxylic acid–TBP–H_2O, effect of hydrogen bonding on uranium distribution in, 20: 18845
Cd–H_2O, neutron scattering in, reaction rate curves for, (E/T), 20: 19776 (AE-223)
$CsNO_3$–$UO_2(NO_3)_2$–H_2O, thermodynamic properties of compound formation in, at 25°C, 20: 18696
dodecane–HNO_3–TBP–$UO_2(NO_3)_2$–H_2O, equilibrium relations for, for nitric acid-uranyl nitrate extraction, 20: 18844
Gd–H_2O, neutron scattering in, reaction rate curves for, (E/T), 20: 19776 (AE-223)
methanol–H_2O, radiolysis of, yields of hydrogen from gamma, 20: 18736
pyridine–H_2O, radiolysis of, yields of hydrogen from gamma, 20: 18736
steam–H_2O, flow in vertical tubes, 20: 18869(R) (NYO-3114-10)
steam–water, phase velocity distribution for flowing systems of, 20: 18874
steam–water, void fraction measurement using acoustic methods, 20: 20187 (EURAEC-1361)
WATER-d_2
critical solution temperatures of phenols in, 20: 18720
effects on active transport of arabinose, glucose, and sodium in hamster intestine, 20: 18212
effects on cellular and protein resistance to heat and hydrostatic pressure, 20: 18218(T)
effects on muscle relaxation in rabbits, 20: 18228
effects on oxidation of cholesterol and sodium octanoate by rat liver mitochondria, 20: 18217
effects on radioinduced fluorescence in terbium chelate systems in, 20: 18683
isotopic analysis of, by infrared spectrometry, 20: 18590
micelle formation and hydrophobic bonding of sodium decyl and sodium dodecyl sulfates in, 20: 18687
neutron scattering by, thermal, (T), 20: 19781 (JAERI-1095)
neutron scattering by, cross sections for slow, (E/T), 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
solvent properties for benzenesulfonic acid, isotope effects on, 20: 18643
WATER-t_2
light emission from aqueous solution of, 20: 18813
uses for labeling menaquinone and phylloquinone, 20: 18711
WATER COOLED REACTORS
coolant kinetics of heterogeneous, research on, 20: 20178(R) (STL-372-27)
coolant temperature monitor for, design of, 20: 20186 (DP-834)
coolant void formation in, in-pile capsule measurements of transient, (E), 20: 20179(R) (STL-372-27, pp 3-12)
coolant void fraction determination using simulated boiling in exponential piles, (E), 20: 20216
fuel dispersal in, heat conduction criteria for preventing molten, (T), 20: 20180(R) (STL-372-27, pp 22-35)
power modulation of, high-pressure loop for measuring boiling void response to, 20: 18872(R) (STL-372-27, pp 13-21)
WATER MODERATED REACTORS
control rod reactivity worths for uranium oxide fueled, cadmium–indium–silver, 20: 20210 (WCAP-3269-39)
WATER SUPPLIES
analysis for radioactive contaminants, methods for, 20: 18615
radioactivity in, Jan. to July, 1965, 20: 18972
WATER VAPOR
effects on transition metals at 1 and 8 torr, 20: 19197
WATER WAVES
interactions of, Feynman diagrams and rules for, 20: 18936
WAXES
effects on buoyancy of fish, 20: 18210(R) (UCLA-12-576, pp 16-25)
WELDED JOINTS
corrosion of niobium–zirconium, by water and steam, 20: 19195
WELDING
methods of, for high-temperature fuel elements, 20: 20183
WELDS
inspection of, betatron detector with scintillation counters for, 20: 19233
WELL LOGGING
theory for epithermal-neutron, 20: 18932
WHEAT
radiation effects on, effects of pre- and post-irradiation thermal treatment on, 20: 18323

radiation effects on, mutagenic, 20: 18409
radiation effects on, following seed soaking in phosphorus-32 solutions, 20: 18442
radioinduced mutation in, use in breeding program, 20: 18322
strontium-90 uptake by, effects of variety on, 20: 18970

WHISTLERS
theory of hydromagnetic, 20: 19666
use for electron density, hydrogen ion concentration, and proton gyrofrequency determination, (E), 20: 19669
use in magnetospheric ionization density structure determination, (E), 20: 19667
use in magnetospheric electron content and density determinations, (E), 20: 19668

WHITESHELL REACTOR NO. 1
shielding for, design of primary, 20: 20308 (AECL-2544)
shielding for, design of secondary, 20: 20309 (AECL-2545)

WIND
height and velocity variations of, equations for, 20: 18988(R) (ORNL-929, pp 58-66)

WINDOWS
failure of beryllium, of CEA hydrogen bubble chamber, 20: 19038 (NYO-10742)

WOOD
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)

WOOL
radiation effects on yellowing of, tracer studies of role of amino acid decomposition in uv, 20: 18281

X

X RADIATION
absorption in crystals, photoelectric, (T), 20: 20147
absorption in K shell of silicon in gaseous silicon chlorides, spectra of, (E), 20: 19389
absorption in L shell of germanium in gaseous germanium chlorides, spectra of, (E), 20: 19389
detection and measurement of cosmic, counter telescope for, 20: 19030 (N-65-17266)
detection of low-energy, design of scintillation camera for, 20: 19089
detection using plastic scintillator, energy dependence of efficiency of, 20: 19066
dosimetry at interfaces, 20: 18952
dosimetry in bones, review of experimental and theoretical methods for, 20: 18954
dosimetry in thin phantoms, 20: 18977
dosimetry of, effects of bone geometry on soft-tissue, 20: 18978
dosimetry of, for tumor radiotherapy, 20: 18521
dosimetry of, for mammary carcinoma therapy, 20: 18545
dosimetry of, units for, 20: 18951
effects in Drosophila, genetic, 20: 18332
effects of low-dose diagnostic, on development of fetuses and babies, 20: 18536
effects of sieve-controlled, on rabbit ears, 20: 18357
effects of, combined with magnetic fields on barley seeds, 20: 18387
effects of, combined with magnetic field on plant germination and seedling development, 20: 18388
effects of, combined with acceleration or vibrations on mitosis in mouse marrow, 20: 18439
effects of, combined with radium on cervical cancer, 20: 18309
effects of, combined with radium on cervical cancer, 20: 18550
effects of, review of LET and RBE in, 20: 18362
effects on ACTH, magnetic, 20: 18479
effects on α-aminoisobutyric acid crystals at 77°K, ESR spectral studies on free radicals in, 20: 18750
effects on avoidance behavior of rats, 20: 18339
effects on bacteria, effects of iodoacetamide on, 20: 18446
effects on bacteria, 20: 18481
effects on barley seeds, effects of magnetic fields on, 20: 18387
effects on barley seedlings and seeds, 20: 18411
effects on barley seeds, genetic, 20: 18418
effects on barley seeds, protective effects of carbonates and phosphates against, 20: 18435
effects on behavior of primates, 20: 18283 (AD-611869, pp 375-89)
effects on bone marrow in man, 20: 18381
effects on bone marrow, effects of lysozyme on, 20: 18494
effects on carbon-14-labeled orotic acid incorporation into rat RNA, 20: 18263
effects on carcinogenesis following childhood radiotherapy, 20: 18412
effects on cardiac function, 20: 18328
effects on catecholamine content in ground squirrels, 20: 18291 (N-65-17058)
effects on central nervous system in cats and rats, 20: 18292(R) (N-65-17068)
effects on chemical reactions between 3,4-benzopyrene and DNA, 20: 18788
effects on chlorine-35 NQR in sodium chlorates, 20: 20118
effects on chromosomes in Vicia root-meristem, dose-response parameters for aberrant, 20: 18350
effects on chromosomes in Ehrlich ascites tumor cells, oxygen enhancement ratio for, 20: 18352
effects on color center development in sodium fluoride at 80 and 200°K, 20: 20106 (COO-1044-23)
effects on colorless and pigmented bacteria, lethal, 20: 18361
effects on concentration of oxidized and reduced TPN in rat organs, 20: 18343
effects on cytochrome c in eyes, 20: 18261(T)
effects on defects in potassium chlorate monocrystals, 20: 20117
effects on density changes and F-center concentration in potassium chlorides, 20: 20163
effects on deposition of injected fibrinogen in rats, tracer study, 20: 18294(R) (TID-22766)
effects on diploid and haploid Saccharomyces, biological, 20: 18405
effects on distant chromosomes in mouse bone marrow, 20: 18356
effects on DNA and RNA metabolism in rat spleen, 20: 18341
effects on DNA content in rat liver, effects of ploidy on, 20: 18260
effects on DNA in *Micrococcus radiodurans*, 20: 18269
effects on DNA synthesis in human cell cultures, 20: 18264
effects on DNA synthesis in embryonic mouse cells, 20: 18265
effects on DNA synthesis in HeLa cells, effects of DNA replication on, 20: 18267
effects on DNA synthesis and DPN content in Ehrlich ascites carcinoma cells, tracer study, 20: 18270
effects on DNA synthesis in normal and tumorous tissue, 20: 18271
effects on DNA synthesis in mouse ascites tumor cells, 20: 18266
effects on DNA, effects of purine deprivation on, 20: 18256
effects on Drosophila genetics, effects of dose on, 20: 18324
effects on Drosophila, genetic, 20: 18333
effects on Drosophila sperm, mutagenia, 20: 18336
effects on Drosophila, genetic, 20: 18415
effects on Drosophila spermatogenesis, 20: 18310
effects on Ehrlich's adenocarcinoma, qualitative and quantitative, 20: 18396
effects on embryonic cells of mice and rats, effects on DNA induction by Polyoma virus, 20: 18369
effects on erythrocyte membranes, 20: 18454
effects on ESR spectra of albumin and methionine, 20: 18791
effects on ESR spectra of potassium sulfate at 77 and 300°K, 20: 18734
effects on estrus cycle in mice, 20: 18403
effects on eye lenses of mice, 20: 18185(R) (BNL-929, pp 126-47)
effects on femoral neck following therapy for gynecological cancer, 20: 18407
effects on food intake by rats, effects of chlorpromazine on, 20: 18367
effects on formation of mononucleated giant erythropoietic cells, 20: 18325
effects on glycoprotein content in rat serum, 20: 18258
effects on gold-198 uptake by lymph nodes in dogs, 20: 18306
effects on granulocyte blood picture in man, 20: 18381
effects on grass seeds, effects of moisture content on, 20: 18382
effects on growth of wheat, effects of thermal treatment on, 20: 18323
effects on growth of cellular transplants in mice, 20: 18304
effects on growth of transplanted mouse tumors, 20: 18460
effects on growth of carcinoma and embryonal tissues in culture, effects of actinomycin on, 20: 18461
effects on growth of hamster melanomas, 20: 18463
effects on hatchability of *Artemia salina* oocytes, effects of low temperature on, 20: 18447
effects on hematopoiesis in mice, protective effects of intestinal shielding against, 20: 18432
effects on hemolysis and membrane permeability of erythrocytes, 20: 18468
effects on incidence and latency of lymphosarcomas in mice, 20: 18317
effects on ion mobilities in carbon tetrachloride, dioxane, ethyl ether, and hexane, 20: 18724 (BNL-10012)
effects on jute plants, genetic, 20: 18385
effects on keratinization in squamous cell carcinomas following radiotherapy, 20: 18255
effects on lactate dehydrogenase activity, 20: 18451
effects on leukemia in germfree mice, 20: 18371
effects on lipid metabolism in rabbits and rats, 20: 18375
effects on liquid tetramethylsilane, mechanism and yields from, 20: 18729(R) (NYO-2007-9)
effects on lung carcinomas, effects of actinomycin D and 5-fluorouracil on, 20: 18539
effects on lung cancers, effects of actinomycin on, 20: 18541
effects on lymphoma cells, effects of 5-bromouracil on, 20: 18445
effects on maize, genetic, 20: 18334

effects on man, effects of pyridine diphosphate nucleotides on therapeutic, 20: 18535
effects on *Medicago polymorpha*, 20: 18312
effects on mice after exposure of 35 generations, 20: 18289(R) (LA-3432, pp 56-101)
effects on mice, biological, 20: 18454
effects on mice, biological, 20: 18467
effects on mice, carcinogenic, 20: 18286 (EUR-2462.1)
effects on mice, etiology of tumorigenic, 20: 18359
effects on mice, effects of adrenal hormones on, 20: 18437
effects on mice, effects of bacterial endotoxin on, 20: 18496
effects on mice, mechanisms for leukemogenic, 20: 18317
effects on mice, mechanisms in aminothiol and anoxia protection against, 20: 18431
effects on mice, protective effects of endogenous sulfhydryl compounds against, 20: 18433
effects on mice, protective effects on 5-BUdR combined with MEA against, 20: 18498
effects on mice, protective effects of 5-BUdR against, 20: 18498
effects on mice, protective effects of MEA against, 20: 18498
effects on mice, protective effects of psychotropic drugs against, 20: 18501
effects on microorganisms, use in size estimations, 20: 18314
effects on mitosis in rat bone marrow cells, protective effects of sodium against, 20: 18326
effects on mitosis in regenerating rat liver, 20: 18457
effects on mitotic delay in spermatogenesis of *Drosophila melanogaster*, 20: 18354
effects on morphology of cells of peritoneal cavity of mice, 20: 18285 (AD-630103)
effects on MOS transistor capacitance-voltage characteristics, (E), 20: 19113
effects on mouse fetuses, protective effects of splenectomy against x, 20: 18436
effects on mouse spermatozoa, effects of dose on lethal mutagenic, 20: 18351
effects on Neurospora, utilization of mutagenic, 20: 18347
effects on nuclear structure of rat thymocytes, 20: 18455
effects on nucleic acid synthesis in rats, 20: 18495
effects on Paramecium, temperature-sensitive mutagenic, 20: 18348
effects on Paramecium, conditions affecting yield of temperature-sensitive mutagenic, 20: 18349
effects on phosphorus-32 uptake by rat kidney and liver, 20: 18379
effects on physiology of muscles, 20: 18293 (NP-14898)
effects on pigments in mouse hair, effects of melanogenetic substrates on, 20: 18502
effects on plant germination and seedling development, 20: 18388
effects on plants, genetic, 20: 18420
effects on plasmocytomas, therapeutic, 20: 18551
effects on proliferative capacity of isolated carrot root cells, 20: 18395
effects on properties of ruby for use as laser, 20: 20110 (NASA-TN-D-3379)
effects on protein synthesis in stem of rat brain, 20: 18295(R) (UCLA-12-576, pp 27-56)
effects on pulmonary tissues, inflammatory, 20: 18543
effects on rabbit hearts, effects of sodium thiosulfate on, 20: 18456
effects on rat bone marrow, cytological, 20: 18534
effects on rat carcinomas, effects of cytotoxic and antimetabolite drugs on, 20: 18377
effects on rat kidneys, pathological, 20: 18284 (AD-629512)
effects on rats, effects of parabiosis on tumorigenic, 20: 18318
effects on rats, effects of hypoxia on, 20: 18272
effects on rats, effects of calf tissue extract on, 20: 18497
effects on rats, leukopenic, 20: 18504
effects on rats, physiological, 20: 18458
effects on rats, synergism with thermal burns, 20: 18184(R) (BNL-929, pp 115-25)
effects on regeneration in Axolotl, 20: 18337
effects on respiration in Bombyx eggs, 20: 18301
effects on rice plants, genetic, 20: 18416
effects on rice seed, genetic, 20: 18414
effects on serotonin levels in rabbit blood, 20: 18257
effects on SH content of *Serratia marcescens*, 20: 18448
effects on smallpox immunity in rabbits, 20: 18408
effects on solid-state polymerization of *N*-vinylsuccinimide with succinimide, 20: 18776
effects on sorption of carbon dioxide by aluminum oxide at 20 to 350°C, 20: 19264
effects on spinal cord, late pathological, 20: 18406
effects on spores of *Bacillus cereus*, 20: 18344
effects on stilbene, effects of naphthalene, phenanthrene, and triphenylene on isomerization by, 20: 18735
effects on succinamide single crystals, ESR and tracer studies of, 20: 18757
effects on surface-area and -energy of calcia irradiated during calcination, 20: 19271
effects on taste response in rats, 20: 18294(R) (TID-22766)
effects on thymectomized mice, 20: 18193
effects on toxicity of amphetamine in mice, 20: 18380
effects on Tribolium, factors affecting, 20: 18302
effects on urinary glucuronide excretion by rats, 20: 18287 (EUR-2638.1)
effects on verrucous carcinoma of oral cavity, anaplastic, 20: 18547
effects on vitamin C content in papayas, 20: 18248(R) (UH-235P5-1, pp 52-4)
effects on yeast, genetic, 20: 18190(R) (UCRL-16613)
emission of K, in fission, (E/T), 20: 20365
emission spectra from sun, isothermal quiet-corona model for line intensities in soft, 20: 19338
exposure frequency during pregnancy, survey of, 20: 18506
exposure to, measurement units for, 20: 18951
induction in metals, use of, for measuring metallic corrosion, 20: 19196
intensity in ionosphere, sunspot activity correlations with, 20: 19647
lymphosarcoma induced in mice by, lymphoma induction by extracts from, 20: 18359
measurement of, from plutonium-239 deposited in lungs, 20: 18186(R) (LA-3432, pp 102-29)
production from electron precipitation in auroral-zone ionosphere, (E), 20: 19671
production in auroral zone from electron precipitation in atmosphere, 20: 19665
production in auroral-zone D region, energetic electron-precipitation determination from, (E), 20: 19672
resistance of barley to, induction of, 20: 18411
scattering by neutron-irradiated diamond crystals, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
scattering of, Raman lines in, (E), 20: 18559 (CALT-221-14)
transmission through crystals, effects of crystal perfection on, 20: 20365

X-RAY BEAMS
effects on tissues, biological, 20: 18548
use of high-LET, for therapy, 20: 18507 (BNL-10009)

X-RAY EQUIPMENT
development of, for fluorescence analysis of ore slurries, 20: 18593

X-RAY FLUORESCENCE ANALYSIS
use with radioactive sources for ore analysis, 20: 18593

X-RAY SPECTROMETERS
design of portable, 20: 20365

XENON
diffusion in zirconium carbides, 20: 20177(R) (BNL-929, pp 83-105)
effects on radiolysis of deuterated hydrocarbons in presence of hydrogen, proton-transfer, 20: 18742
electron distribution in, solution of Thomas-Fermi-Dirac equation for, 20: 19366
equation of state for, high-pressure, 20: 20365
lithium-6 reactions with, Massey-Mohr total elastic cross sections for, (E/T), 20: 19872
separation from krypton by gas chromatography, 20: 18825 (KFK-365)
sorption in reactor dehydrator unit, tracer technique for measuring dynamic and static, 20: 18626 (GA-6865)

XENON COMPOUNDS
preparation and properties of, review on, 20: 18623 (CEA-Bib-58)

XENON IONS
production by high-temperature hollow cathode ion source, 20: 19002
reactions with tungsten at 200 ev to 4 kev, diffusion of trapped gas following, 20: 20128
sputtering reactions on oriented gold foils at 50 kev, (E), 20: 19372

XENON ISOTOPES
isotopic mixing constants of, volume, (T), 20: 19970
separation on-line from californium-252 spontaneous fission, 20: 19888

XENON ISOTOPES Xe-125
ranges in tantalum oxide, 20: 20136
reactions with monocrystalline tungsten at 0.1 to 1.5 Mev, range distributions from, (E), 20: 20135

XENON ISOTOPES Xe-128
preparation by neutron irradiation of aluminum iodide, 20: 18731

XENON ISOTOPES Xe-129
energy levels of, structure from isomeric transition in, (T), 20: 19970
energy levels of, half life of 40-kev, (E/T), 20: 19273(R) (BNL-929, pp 3-43)
transport in meteorites, mechanism of, 20: 18901

XENON ISOTOPES Xe-131
energy levels of, structure from isomeric transition in, (T), 20: 19970
sorption by activated charcoal, collector design measuring, 20: 18994 (SGAE-PH-31/1965)

XENON ISOTOPES Xe-133
conversion-electron emission from, in monocrystalline tantalum, 20: 20129

injection in monocrystalline copper at 40 kev, thermal release following, 20: 20145
ranges in gold, 20: 20136
ranges in uranium dioxide, 20: 20136
reactions with monocrystalline tungsten at 0.1 to 1.5 Mev, range distributions from, (E), 20: 20135
tracer use for measuring sorption isotherms for coolant in HTGR, 20: 18626 (GA-6865)

XENON ISOTOPES Xe-135
energy levels of, structure from isomeric transition in, (T), 20: 19970

XENON ISOTOPES Xe-137
separation in fission of uranyl stearate using on-line isotope separator, 20: 19887

XENON ISOTOPES Xe-139
separation in fission of uranyl stearate using on-line isotope separator, 20: 19887

XENON ISOTOPES Xe-140
separation in fission of uranyl stearate using on-line isotope separator, 20: 19887

XENON OXIDES
molecular structure of, semiempirical, (T), 20: 18641

Y

YANKEE POWER REACTOR
core evaluation for, 20: 20272(R) (WCAP-6079)

YEASTS
effects of dimethyl sulfoxide on, inhibitory, 20: 18206(R) (N-65-16815)
genetic analysis of *Saccharomyces cerevisiae*, 20: 18194
genetic analysis of Saccharomyces, 20: 18195
metabolism in, effects of cystamine on, 20: 18372
phosphate release and reproduction of irradiated, effects of radioprotective compounds on, 20: 18503 (AD-611869, pp 169-83)
radiation effects on, mechanisms of lethal, 20: 18405
radiation effects on, charged particle-beam, 20: 18190(R) (UCRL-16613)
radiation effects on transfer RNA in, uv, 20: 18249
radiation effects on phosphate release by *Saccharomyces cerevisiae*, 20: 18503 (AD-611869, pp 169-83)
radiosensitivity of, effects of cystamine on β, 20: 18372

YTTERBIUM
effects on x-ray fluorescent spectrometric determination of yttrium, 20: 18611
neutron inelastic scattering by, fast, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599
vapor pressure of solutions of, in liquid ammonia at −75.9°C, 20: 18689

YTTERBIUM ALCOHOLATES
preparation and properties of, 20: 18652

YTTERBIUM ALLOYS
Ge–Yb, crystal structure of, at or near equiatomic proportions, 20: 19225

YTTERBIUM COMPOUNDS
hexaammoniate, preparation and properties of, 20: 18689

YTTERBIUM ISOTOPES Yb-164
energy levels of, high-spin rotational, (E/T), 20: 19953

YTTERBIUM ISOTOPES Yb-165
beta decay of, gamma spectra from, (E), 20: 19862

YTTERBIUM ISOTOPES Yb-166
energy levels of, high-spin rotational, (E/T), 20: 19953

YTTERBIUM ISOTOPES Yb-170
energy levels of, gyromagnetic ratio and mean life of first excited rotational, 20: 19945

YTTERBIUM ISOTOPES Yb-171
nitrogen-14 inelastic scattering by, Coulomb excitation in, (E), 20: 19959

YTTERBIUM ISOTOPES Yb-172
energy levels of, gyromagnetic ratio and mean life of first excited rotational, 20: 19945

YTTERBIUM ISOTOPES Yb-174
energy levels from thulium-174 decay, parity and spin of, (E), 20: 19944
energy levels of, gyromagnetic ratio and mean life of first excited rotational, 20: 19945

YTTERBIUM ISOTOPES Yb-175
energy levels from thulium-175 decay, parity and spin of, (E), 20: 19944

YTTERBIUM ISOTOPES Yb-176
energy levels of, gyromagnetic ratio and mean life of first excited rotational, 20: 19945

YTTERBIUM OXIDES
thermal expansion below room temperature, 20: 20168

YTTERBIUM SULFIDES
Cu_2S–Yb_2S_3, phase studies, 20: 18644

YTTRIUM
content in eclogites from Nowa Wies in Snieznik Klodzki, Poland, 20: 18900
determination in aqueous solutions by x-ray fluorescent spectrometry, 20: 18611
determination in rare earth mixture by x-ray fluorescent spectrometry, 20: 18611
determination in thorium and uranium dioxides, x-ray spectrographic, 20: 18558 (AECL-2526)
neutron activation at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
separation from americium and curium by electrophoresis in EDTA and α-hydroxyisobutyric acid solutions, 20: 18562(R) (EUR-2640.e)
separation from rare earths, thorium, and uranium by reversed-phase chromatography using methylenebis(di-*n*-hexylphosphine oxide), 20: 18599

YTTRIUM ALCOHOLATES
preparation and properties of, 20: 18652

YTTRIUM ALLOYS
Co–Gd–Y, magnetic properties of intermetallic compounds of, (E/T), 20: 20141

YTTRIUM ISOTOPES Y-87
energy levels of, structure from isomeric transition in, (T), 20: 19970

YTTRIUM ISOTOPES Y-88
production of isomeric, in neutron activation of yttrium at 14.3 Mev, (E), 20: 19809 (CEA-R-2900)
solvent distribution between bis(2-chloroethyl) ether and hydrochloric acid, coefficient of, 20: 18571 (ORNL-TM-1420)

YTTRIUM ISOTOPES Y-89
neutron capture by, isomer ratios from fast, (T), 20: 19920

YTTRIUM ISOTOPES Y-90
beta decay of, direct-interaction ionization probability for, (T), 20: 19934
effects on cutaneous angiomas, 20: 18528
effects on pituitary gland, 20: 18532
properties of radioapplicators of strontium-90 and, 20: 18522

YTTRIUM ISOTOPES Y-91
excretion of, from efficacy of EDTA, DTPA, and TTHA for promoting, 20: 18438
uptake by marine organisms, correlation with buildup factor, 20: 18215

YTTRIUM ISOTOPES Y-92
energy levels of, structure from isomeric transition in, (T), 20: 19970

YTTRIUM SULFIDES
Cu_2S–Y_2S_3, phase studies, 20: 18644

YTTRIUM VANADATES
europium-ion uv fluorescence in polycrystalline matrices of, 20: 20119

Z

ZEBRA
neutron Doppler measurements in core 5, 20: 20310 (AEEW-R-465)

ZINC
content in mammalian cells, effects of cell cycle stage on, 20: 18204(R) (LA-3432, pp 130-77)
determination in quartz crystals from Providencia area, Zacatecas, Mexico, activation, 20: 18631 (NYO-2266-1)
determination in sea water, activation, 20: 18576(R) (TID-22660)
metabolism in cirrhotic and normal liver of man, tracer study, 20: 18222
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
preparation of kryptonated, by ion bombardment, 20: 18570(R) (NYO-2757-5)
separation from rare earths by ion exchange chromatography, 20: 18827

ZINC ALLOYS
Al–Zn, radiation effects on crystal structure of, at −196°C, neutron, 20: 19260

ZINC COMPLEXES
with thiols, radiosensitivity effects in mice, 20: 18450

ZINC GERMANATES
preparation of kryptonates of, by diffusion, 20: 18570(R) (NYO-2757-5)

ZINC IONS
precipitation with calcite from aqueous solutions, 20: 18631 (NYO-2266-1)

ZINC ISOTOPES
preparation of foil targets of, 20: 19297 (IAE-973)

ZINC ISOTOPES Zn-64
neutron reactions (n,2n) at 10 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))
neutron reactions (n,p) at 0 to 20 Mev, cross sections for, 20: 19810 (EUR-119.e(Vol.2))

ZINC ISOTOPES Zn-65
content in marine organisms in northeast Pacific Ocean, 20: 18903 (RLO-1750-3)
decay of, branching ratios for electron-capture, (E), 20: 19831 (NP-15912)

elimination of chloride-incorporated, chelation and isotope exchange methods for, 20: 18216
separation from copper-64 and manganese-54 in sea water, method for, 20: 18576(R) (TID-22660)
separation from neutron-irradiated biological materials, use of Szilard-Chalmers effect in, 20: 18583
sorption from sea water by montmorillonite clay, 20: 18576(R) (TID-22660)
uses for determining transition temperatures of crystal systems, 20: 18677
ZINC ISOTOPES Zn-67
energy levels of, structure from isomeric transition in, (T), 20: 19970
ZINC ISOTOPES Zn-69
energy levels of, structure from isomeric transition in, (T), 20: 19970
production by neutron irradiation of zinc-68, 20: 18818(P)
ZINC NITRATES
analytical use for ion exchange separation of americium, curium, and rare earths, 20: 18562(R) (EUR-2640.e)
ZINC OXIDES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
ZINC SILICATES
preparation of kryptonated, by diffusion, 20: 18570(R) (NYO-2757-5)
ZINC SULFATES
transition temperature in iron or magnesium sulfates, tracer studies of, 20: 18677
ZINC SULFIDES
properties of rare earth doped, electric and optical, 20: 20122
ZINC TELLURIDES
tellurium-125 Mössbauer effect in, (E), 20: 20148
ZIRCALOY-2
creep of cold-worked pressure tubes of, equation for, 20: 19203 (AECL-2528)
oxidation films on, effects of environment and surface preparation on structure of, 20: 19188(R) (GEAP-5001)
performance as fuel cladding under coolant-loss conditions, 20: 20221
reactions with uranium nitride at 600 to 900°C, 20: 19187 (BMI-1760)
ZIRCALOY-4
welding of, to aluminum, process development for explosive, 20: 19177(R) (BMI-1757)
ZIRCONIUM
determination in uranium dioxide, x-ray spectrographic, 20: 18558 (AECL-2526)
determination using *N*-benzoylphenylhydroxylamine, spectrophotometric, 20: 18586
effects on electric and mechanical properties of aluminum, 20: 19241
effects on thorium dioxide–uranium dioxide fuel particle solubility in fluoride–nitric acid solutions, 20: 18819 (AAEC/E-143)
friction properties of, *in vacuo*, relation of lattice parameter to, 20: 19206 (N-65-17331)
metallography of twinning in, 20: 20365
neutron elastic scattering at 0.68 to 1.25 Mev, (E/T), 20: 19805(R) (ANL-7110, pp 1-28)
oxidation by water vapor at 1 and 8 torr, 20: 19197
oxidation films on, effects of environment and surface preparation on structure of, 20: 19188(R) (GEAP-5001)
polishing of, electrolytic process for, 20: 19186(P)
reactions with uranium nitride at 600 to 700°C, 20: 19187 (BMI-1760)
separation from hafnium by liquid-liquid partition of their thiocyanates, 20: 18828
separation from niobium by solvent extraction using benzoyltrifluoroacetone or trifluoroacetylacetone, 20: 18833
separation from niobium by solvent extraction using 8-hydroxyquinaldoxime and caproic acid, 20: 18849
separation from niobium by solvent extraction using *N*-benzoylphenylhydroxylamine, 20: 18586
separation from rare earths by ion exchange chromatography, 20: 18827
thermodynamic properties at high temperatures and pressures, 20: 19217 (NP-15933)
ZIRCONIUM ALLOYS
Al–Zr, properties of, electric and mechanical, 20: 19241
Hf–Zr, electrolytic polishing, 20: 19186(P)
Mo–Nb–V–Zr, compatibility of rocket nozzles of, with hydrogen, 20: 19228
Mo–Ti–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on TZM, 20: 18567 (MAB-217-M)
Mo–Zr, annealing of, tracer studies of grain boundary migration in, 20: 19251
Mo–Zr, internal friction in deformed, 20: 19250
Nb–Ta–W–Zr, analysis for alloying elements and impurities, comparison of results from 25 laboratories on FS-85, 20: 18567 (MAB-217-M)
Nb–V–Zr, development and properties of niobium-base Cb-753, 20: 19214 (N-65-22097)
Nb–Zr, corrosion of welded joints of, by water and steam, 20: 19195
Nb–Zr, magnetization of superconducting, effect of external current on, (E/T), 20: 19735
Nb–Zr, microstructure of cast, with low oxygen contents, 20: 19245
Nb–Zr, phase transformation in, start temperature for martensitic, 20: 19230
Nb–Zr, superconductivity of, effects of omega-transformation on, (E), 20: 19722 (N-65-17099)
ZIRCONIUM BORIDES
preparation by carbon reduction of oxide with boric oxide, 20: 19702
stainless steel–ZrB_2, fabrication of dispersions of, process development for, 20: 19177(R) (BMI-1757)
ZIRCONIUM CARBIDES
diffusion of xenon in, 20: 20177(R) (BNL-929, pp 83-105)
radiation effects on pellets of, 20: 20177(R) (BNL-929, pp 83-105)
UC–ZrC, development as cathodes for thermionic space reactors, 20: 19207(R) (N-65-21346)
UC–ZrC, diffusion of iridium, rhenium, and rhenium–tungsten alloy in, 20: 19211(R) (N-65-21350)
UC–ZrC, diffusion of iridium, rhenium, and rhenium–tungsten alloy in, at 1800°C, 20: 19212(R) (N-65-21351)
UC–ZrC, emission and vaporization testing of, in cesium vapor, 20: 19208(R) (N-65-21347)
UC–ZrC, vacuum emission of thermionic cell cathodes of, 20: 19209(R) (N-65-21348)
UC–ZrC, vaporization testing in cesium vapor, 20: 19210(R) (N-65-21349)
UC–ZrC, vaporization testing of, in cesium vapor, 20: 19211(R) (N-65-21350)
UC–ZrC, vaporization of, effects of cesium vapor pressure and sample density on rate of, 20: 19212(R) (N-65-21351)
Zr–ZrC, phase diagram, 20: 19249
ZIRCONIUM COMPLEXES
with DTPA, radionuclide removal from body using, 20: 18438
ZIRCONIUM HYDRIDES
neutron scattering by, cross sections for slow, (E/T), 20: 19778(R) (GA-6824)
neutron thermalization in, integral, (E/T), 20: 19778(R) (GA-6824)
ZIRCONIUM ISOTOPES
energy levels of, structure from isomeric transition in, (T), 20: 19970
ZIRCONIUM ISOTOPES Zr-94
proton inelastic scattering by, angular distributions and analog state spins from, (E), 20: 19917
ZIRCONIUM ISOTOPES Zr-95
content in marine organisms in northeast Pacific Ocean, 20: 18903 (RLO-1750-3)
content in organisms and water in Gulf of Mexico, 20: 18200 (NYO-3450-1, pp 109-29)
content in Pacific Ocean surface water near mouth of Columbia River, 20: 18902 (RLO-1725-41)
content in Pacific Ocean sediments near mouth of Columbia River, 20: 18902 (RLO-1725-41)
distribution in sea water in Swordfish Program, 20: 18576(R) (TID-22660)
energy levels from zirconium-94 (p,p′) reactions, spin of, (E), 20: 19917
separation from sea water, method for, 20: 18576(R) (TID-22660)
ZIRCONIUM OXIDES
reactions with urania, effects of temperature of, 20: 20365
structure of corrosion films of, on Zircaloy-2 and zirconium, 20: 19188(R) (GEAP-5001)
thermodynamic properties of gaseous, liquid, and solid, at 2180 to 6000°K, 20: 19202 (AD-629571)
$LuO_{1.5}$–ZrO_2, electric conductivity of, 20: 19243
$ScO_{1.5}$–ZrO_2, electric conductivity of, 20: 19243
ZIRCONIUM PHOSPHATES
properties and stoichiometry as ion exchange material, 20: 18841
ZIRCONIUM SYSTEMS
Ta–ThO_2–W–Zr, development of oxidation-resistant, 20: 19193
Zr–ZrC, phase diagram, 20: 19249
ZIRCONIUM THIOCYANATES
separation from hafnium thiocyanate by solvent extraction using 4-methyl-2-pentanone, 20: 18828
ZIRCONS
age estimation of, by uranium–lead method, Ontario, Canada, 20: 18929
age estimations of, using lead-uranium method, 20: 18924(R) (NYO-1669-11)
ZIRCONYL OXALATES
properties for use as ion exchanger for alkali cations, 20: 18840

REPORT NUMBER INDEX

Reports, conference papers and proceedings, numbered translations, and patents abstracted during the period are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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Report No.
AAEC-E-
142
143
AAEC-TM-
302
ACNP-
62599(Vol.1)
62599(Vol.2)
65579
ACRH-
24
AD-
611869
616703
629511
629512
629571
629709
629784
629948
630042
630103
630123
630199
630338
AE-
214
220
223
AEC-tr-
6644
6700
AECD-EP-
8
AECL-
2260
2525
2526
2528
2531
2533
2544
2545
AED-C-
12-13(Pt.1)
12-13(Pt.2)
AEEW-M-
581
AEEW-R-
260
432
438
453
464
465
466
AFCRL-
66-17
AFWL-TR-
65-111
AGN-TM-
412
AI-Memo-
8810(Rev.1)
ANL-
6568

Report No.	Abstract No.	Availability
AAEC-E–	**(Australian)**	
142	20-19168	Dep. mn
143	20-18819	Dep. mn
AAEC-TM–	**(Australian)**	
302	20-20195	Dep. mn
ACNP–	**(Misc.)**	
62599(Vol.1)	20-20306	Dep. mn. CFSTI $7.43 cy, $2.00 mn
62599(Vol.2)	20-20307	Dep. mn. CFSTI $5.00 cy, $1.00 mn
65579	20-20184	Dep. mn. CFSTI $3.00 cy, $0.75 mn
ACRH–		
24	20-18422	Dep. mn. CFSTI $5.00 cy, $1.00 mn
AD–	**(Misc.)**	
611869	20-20353	CFSTI $8.35 cy, $2.25 mn
616703	20-19014	CFSTI $3.00 cy, $0.50 mn
629511	20-19015	CFSTI $2.00 cy, $0.50 mn
629512	20-18284	CFSTI $1.00 cy, $0.50 mn
629571	20-19202	CFSTI $1.00 cy, $0.50 mn
629709	20-19016	CFSTI $1.00 cy, $0.50 mn
629784	20-18938	CFSTI $3.00 cy, $0.75 mn
629948	20-19093	CFSTI $2.00 cy, $0.50 mn
630042	20-19802	CFSTI $1.00 cy, $0.50 mn
630103	20-18285	CFSTI $1.00 cy, $0.50 mn
630123	20-19995	CFSTI $1.00 cy, $0.50 mn
630199	20-18424	CFSTI $2.00 cy, $0.50 mn
630338	20-18425	CFSTI $2.00 cy, $0.50 mn
AE–	**(Non-AEC)**	
214	20-19414	Dep. mn
220	20-20092	Dep. mn
223	20-19776	Dep. mn
AEC-tr–	**(For complete listing see TID-4025)**	
6644	20-20181	Dep. mn. JCL $2.60 fs, $1.10 mf
6700	20-20182	Dep. mn. CFSTI $3.00 cy, $0.75. JCL $6.60 fs, $2.18 mf
AECD-EP–	**(Pakistani)**	
8	20-19284	Dep. mn
AECL–	**(Canadian)**	
2260	20-18733	Can. J. Chem., 44: 461-75(1966)
2525	20-20225	Dep. mn. AECL $1.00
2526	20-18558	Dep. mn. AECL $0.50
2528	20-19203	Dep. mn. AECL $0.50
2531	20-19272	Dep. mn. AECL $1.00
2533	20-19017	Dep. mn. AECL $0.50
2544	20-20308	Dep. mn
2545	20-20309	Dep. mn
AED-C–	**(Non-AEC)**	
12-13(Pt.1)	20-19803	Dep. mn
12-13(Pt.2)	20-19804	Dep. mn
AEEW-M–	**(British)**	
581	20-20196	Dep. BIS $0.80. HMSO 4s.
AEEW-R–	**(British)**	
260	20-20226	Dep. BIS $0.70. HMSO 3s. 6d.
432	20-18859	Dep. BIS $1.10. HMSO 5s. 6d.
438	20-20197	Dep. BIS $4.00. HMSO 20s. 0d.
453	20-20287	Dep. BIS $1.40. HMSO 7s. 0d.
464	20-20198	Dep. BIS $0.90. HMSO 4s. 6d.
465	20-20310	Dep. BIS $0.90. HMSO 4s. 6d.
466	20-20199	Dep. BIS $1.40. HMSO 7s.
AFCRL–	**(Non-AEC)**	
66-17	20-19996	
AFWL-TR–	**(Non-AEC)**	
65-111	20-19014	See AD-616703
AGN-TM–		
412	20-20227	Dep. mn. CFSTI $4.00 cy, $0.75 mn
Al-Memo–	**(Misc.)**	
8810(Rev.1)	20-20228	Dep. mn. CFSTI $2.00 cy, $0.50 mn
ANL–		
6568	20-19175	Dep. mn. CFSTI $3.00 cy, $0.75 mn
6975	20-19176	Dep. mn. CFSTI $2.00 cy, $0.50 mn
6992	20-18820	Dep. mn. CFSTI $3.00 cy, $0.75 mn
7077	20-18821	Dep. mn. CFSTI $2.00 cy, $0.50 mn
7110	20-20176	Dep. mn. CFSTI $7.22 cy, $2.00 mn
7130	20-19426	Dep. mn. CFSTI $4.75 cy, $2.00 mn
AROD–	**(Misc.)**	
3269:27	20-19802	See AD-630042
AWRE-O–	**(British)**	
4/66	20-20202	Dep. mn. BIS $0.80. HMSO 4s. 0d.
21/66	20-18879	Dep. mn. BIS $0.50. HMSO 2s. 6d.
BMI–	**(Misc.)**	
1757	20-19177	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1760	20-19187	Dep. mn. CFSTI $2.00 cy, $0.50 mn
BMR–	**(Non-AEC)**	
1	20-19032	See N-65-23928
BNL–		
887	20-20230	Dep. mn. CFSTI $3.00 cy, $0.50 mn
929	20-20354	Dep. mn. CFSTI $6.00 cy, $1.25 mn
944	20-20104	Dep. mn. CFSTI $1.00 cy, $0.50 mn
9385	20-20137	Nucl. Instrum. Methods, 38: 254-9(1965)
9469	20-18714	J. Amer. Chem. Soc., 88: 888-93(1966)
9491	20-18687	J. Phys. Chem., 70: 783-6(1966)
9548	20-18384	Radiat. Bot., 6: 21-38(1966)
9602	20-18772	J. Phys. Chem., 70: 935-6(1966)
9681	20-18661	J. Chem. Phys., 44: 2499-2505(1966)
9777	20-19745	Phys. Lett., 20: 339-40(1966)
9782	20-18319	Cancer Res., 26: 509-13(1966)
9806	20-19741	Phys. Lett., 20: 263-4(1966)
9934	20-19533	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10009	20-18507	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10012	20-18724	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10038	20-18508	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10047	20-20344	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10049	20-19286	Dep. mn. CFSTI $1.00 cy, $0.50 mn
10095	20-19287	Dep. mn. CFSTI $2.00 cy, $0.50 mn
10096	20-19288	Dep. mn. CFSTI $2.00 cy, $0.50 mn
BNWL–		
113-12	20-20355	Dep. mn. CFSTI $2.00 cy, $0.50 mn
113-13	20-20356	Dep. mn. CFSTI $2.00 cy, $0.50 mn
189	20-18822	Dep. mn. CFSTI $4.00 cy, $0.75 mn
201	20-19252	Dep. mn. CFSTI $1.00 cy, $0.50 mn
206	20-18860	Dep. mn. CFSTI $3.00 cy, $0.50 mn
BNWL-SA–		
547	20-20231	Dep. mn. CFSTI $2.00 cy, $0.50 mn
569	20-20345	Dep. mn. CFSTI $1.00 cy, $0.50 mn
596	20-20288	Dep. mn. CFSTI $2.00 cy, $0.50 mn
BSR–	**(Non-AEC)**	
1008	20-19107	See N-65-21263
CAL-VS–	**(Non-AEC)**	
1945-X-1	20-19324	See N-65-21300
CALT–		
68-20	20-19289	Dep. mn. CFSTI $1.00 cy, $0.50 mn
68-27	20-19019	Dep. mn. CFSTI $2.00 cy, $0.50 mn
68-30	20-19020	Dep. mn. CFSTI $1.00 cy, $0.50 mn
68-53	20-19021	Dep. mn. CFSTI $2.00 cy, $0.50 mn
68-62	20-19022	Dep. mn. CFSTI $1.00 cy, $0.50 mn
68-64	20-19290	Dep. mn. CFSTI $1.00 cy, $0.50 mn
68-67	20-19291	Dep. mn. CFSTI $1.00 cy, $0.50 mn
221-14	20-18559	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CEA–		
73	20-19305	See TID-22772
CEA-Bib–	**(French)**	
57	20-18622	Dep. mn
58	20-18623	Dep. mn
65	20-19720	Dep. mn
66	20-18855	Dep. mn
CEA-R–	**(French)**	
2847	20-20232	Dep. mn

Report No.	Abstract No.	Availability
2858	20-18801	Dep. mn
2870	20-20233	Dep. mn
2888	20-19356	Dep. mn
2900	20-19809	Dep. mn
2917	20-18802	Dep. mn
2923	20-19777	Dep. mn
2927	20-19170	Dep. mn
CEND–	**(Misc.)**	
3107-261	20-19253	Dep. mn. CFSTI $2.00 cy, $0.50 mn
CEND/PRWRA–		
257A	20-20234	Dep. mn. CFSTI $2.00 cy, $0.50 mn
CERN–	**(European Organization for Nuclear Research)**	
66-4	20-19023	Dep. mn
66-5	20-19292	Dep. mn
66-7	20-19293	Dep. mn
66-9	20-19294	Dep. mn
66-11	20-19295	Dep. mn
CLM-P–	**(British)**	
90	20-19736	J. Sci. Instrum., 42: 913-14(1965)
CLM-R–	**(British)**	
47	20-19721	Dep. mn. BIS $0.50. HMSO 2s. 6d.
48	20-19997	Dep. mn. BIS $1.00. HMSO 5s.
50	20-19998	Dep. mn. BIS $0.30. HMSO 1s. 9d.
CONF-80–	**20-20366**	**(Institute of Nuclear Materials Management 4th Annual Meeting, Buffalo, June 1963)**
CONF-426–	**(IAEA Study Group Meeting on Research Reactor Utilization, Athens, Sept. 1963)**	
(Vol.1)	20-20314	See STI/DOC-56(Vol.1)
(Vol.2)	20-20315	See STI/DOC-56(Vol.2)
CONF-502–	**(International Congress of Nuclear Physics, Paris, July 1964)**	
(Vol.1)	20-19980	
CONF-651–	**(9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug. 31–Sept. 4, 1964)**	
(Pt.A)	20-19774	New York, Plenum Press, 1965. $19.50
(Pt.B)	20-19775	New York, Plenum Press, 1965. $19.50
CONF-610902–	**(EAES Symposium on Reactivity Feedback Mechanisms and Nuclear Reactor Stability, Zurich, Sept. 25–27, 1961)**	
1	20-20311	See EIR-87
CONF-620303–	**20-20367**	**(Fortnight of Nuclear Sciences, Montpellier, France, Apr. 8, 1962)**
CONF-631007–	**20-19120**	**(3rd Work Session on Stable Isotopes, Leipzig, Oct. 28–Nov. 2, 1963)**
CONF-631009–	**20-18530**	**(1st Annual Session of the Society for Nuclear Medicine, Freiburg i. B., Oct. 17–19, 1963)**
CONF-631112–	**(Integrated Contractors Materials Meeting, Livermore, Calif., Nov. 14, 1963)**	
1	20-18947	See RFP-343
CONF-640417–	**(European Meeting of Producers of Radioisotopes, Saclay, Apr. 16–17, 1964)**	
1	20-18804	See SORIN-34
CONF-640512–	**(Symposium on Radiosensitizers and Radioprotective Drugs, Milan, May 23–24, 1964)**	
(Vol.1)	20-18238	Washington, D. C., Butterworths, 1965. $28.50
CONF-640630–	**(Army Science Conference, West Point, N. Y., June 17–19, 1964)**	
(Vol.2)	20-20353	See AD-611869
CONF-640714–	**20-18413**	**(Symposium on Mutations in Quantitative Traits, Ohmiya-machi, Ibaraki-ken, Japan, July 28–29, 1964)**
CONF-640917–	**20-2526 20-20171**	**(4th All-Union Conference on Ferroelectricity, Rostov-on-the-Don, U.S.S.R., Sept. 12–18, 1964)**
CONF-641026–	**20-18199**	**(Symposium on Marine Geochemistry, Kingston, R. I., Oct. 29–30, 1964) See NYO-3450-1**
CONF-650119–	**(15th Annual Conference on Nuclear Spectroscopy and the Structure of the Atomic Nucleus, Minsk, U.S.S.R., Jan. 25–Feb. 2, 1965)**	
(Vol.2)	20-19952	Izv. Akad. Nauk SSSR, Ser. Fiz., 29: 1054-1255(1965)
CONF-650204–	**(Meeting on Thermocouple Technology and the Effects of Nuclear Radiation on Thermocouples, Washington, D. C., Feb. 24–26, 1965)**	
9	20-20185	Dep. mn. CFSTI $2.00 cy, $0.50 mn
CONF-650429–	**20-20281**	**(American Power Conference, Chicago, Apr. 27–29, 1965)**
CONF-650547–	**(American Society of Lubrication Engineers, 20th Annual Meeting, Detroit, May 4–7, 1965)**	
1	20-18891	ORINS
CONF-650549–	**20-18635**	**(International Atomic Energy Agency, Symposium on Exchange Reactions, Upton, N. Y., May 31–June 4, 1965) See STI-PUB-107**
3	20-18706	ORINS
CONF-650565–	**20-19128**	**(3rd Yugoslavian Symposium on Use of Radioactive Isotopes and Radiation in Industry, Hercegnovi, Yugoslavia, May 10–14, 1965)**
CONF-650575–	**(Spring Conference of Digital Equipment Corp. Users Assn., Boston, May 20–21, 1965)**	
1	20-19840	See UCRL-16723
CONF-650576–	**(Nuclear Data Evaluation Conference, Upton, N. Y., May 1965)**	
1	20-20218	See WAPD-T-1823
CONF-650627–	**20-19141**	**(Conference on Electromagnetic Isotope Separators and Related Ion Accelerators, and Their Applications to Physics, Aarhus, Denmark, June 14–18, 1965)**
CONF-650629–	**(Conference on Small-Angle X-Ray Scattering, Syracuse, N. Y., June 24–26, 1965)**	
3	20-19254	Dep. mn. CFSTI $1.00 cy, $0.50 mn
CONF-650635–	**20-19296**	**(2nd International Meeting on Accelerator Targets Designed for the Production of Neutrons, Grenoble, June 21–22, 1965) See EUR-2641.d,f,e**
CONF-650652–	**(6th International Conference on Radiocarbon and Tritium Dating, Pullman, Wash., June 7–11, 1965)**	
12	20-18937	Gmelin, AED-CONF-65-158-4
CONF-650657–	**(International Conference on Physics of X-Ray Spectra, Ithaca, N. Y., June 1965)**	
2	20-18559	See CALT-221-14
CONF-650670–	**(Symposium on Two-Phase Flow, Exeter, England, June 20–23, 1965)**	
1	20-20187	See EURAEC-1361
2	20-18863	See EURAEC-1360
CONF-650704–	**(IAEA Symposium on Thermodynamics, Vienna, July 22–27, 1965)**	
35	20-18637	For translation see KFK-tr-177
CONF-650706–	**(International Conference on the Study of Nuclear Structure with Neutrons, Antwerp, July 19–23, 1965)**	
25	20-19829	See NIJS-R-455
CONF-650725–	**(4th Colloquium on Nuclear Insurance, Berlin, July 8–9, 1965)**	

Report No.	Abstract No.	Availability
1	20-18939	See EUR-2642.f
CONF-650803--	(IAEA Symposium on Nuclear Materials Management, Vienna, Aug. 30–Sept. 3, 1965)	
41	20-18619	ORINS
CONF-650806--	(7th International Conference on Phenomena in Ionized Gases, Belgrade, Aug. 22–27, 1965)	
22	20-20000	See IPP-2/43
CONF-650907--	(11th International Congress of Radiology, Rome, Sept. 24, 1965)	
3	20-18423	See ACRH-24, pp 125-34
CONF-650932--	(Symposium on the Inelastic Scattering of Neutrons by Systems, Upton, N. Y., Sept. 1965)	
11	20-20107	See EUR-2734.e
CONF-650945--	20-19603	(International Conference on Elementary Particles, Oxford, Sept. 19–25, 1965)
5	20-19448	See UCRL-16462
CONF-650966--	(Meeting of the German Chemical Society and "Kekule-Festival", Bonn, Germany, Sept. 13–18, 1965)	
1	20-18561	See EUR-2635.d
CONF-650967--	(Italian Society of Experimental Biology, 34th General Assembly, Sorrento, Italy, Sept. 30–Oct. 2, 1965)	
1	20-18287	See EUR-2638.i
CONF-651001--	(IEEE Nuclear Science Symposium, San Francisco, Oct. 1965)	
18	20-19601	ORAU. Gmelin, AED-CONF-65-293-3
CONF-651004--	(9th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 12, 1965)	
11	20-18578	See TRG-Report-1165
CONF-651005--	(1st International Symposium on Water Desalination, Washington, D. C., Oct. 3–9, 1965)	
2	20-18705	ORAU. Gmelin, AED-CONF-65-276-4
3	20-18704	ORAU. Gmelin, AED-CONF-65-276-5
CONF-651006--	(American Society for Testing Materials, 5th Pacific Area National Meeting, Seattle, Oct. 31–Nov. 5, 1965)	
3	20-19271	ORAU. Gmelin, AED-CONF-65-342-1
CONF-651015--	(American Physical Society, Chicago, Oct. 7, 1965)	
6	20-19950	ORAU. Gmelin, AED-CONF-65-312-24
7	20-19528	ORAU. Gmelin, AED-CONF-65-312-15
CONF-651017--	(Electrochemical Society Meeting, Buffalo, Oct. 10–14, 1965)	
8	20-19201	ORAU. Gmelin, AED-CONF-65-289-8
CONF-651043--	20-19426	(Weak Interactions Conference, Argonne, Ill., Oct. 25–27, 1965)
4	20-19527	ORAU. Gmelin, AED-CONF-65-320-2
5	20-19951	ORAU. Gmelin, AED-CONF-65-320-14
CONF-651044--	(Conference on Programming for Flying Spot Devices, New York, Oct. 24–26, 1965)	
7	20-19044	See UCRL-16508
8	20-19045	See UCRL-16509
13	20-19046	See UCRL-16510
CONF-651051--	(American Physical Society, New England Section, Fall Meeting, Orono, Me., Oct. 8–9, 1965)	
1	20-19719	ORAU. Gmelin, AED-CONF-65-280-1
2	20-20091	ORAU. Gmelin, AED-CONF-65-280-2
3	20-19602	ORAU. Gmelin, AED-CONF-65-280-4
CONF-651060--	(American Public Health Assn., 93rd Annual Meeting, Chicago, Oct. 18–22, 1965)	
1	20-18981	ORAU. Gmelin, AED-CONF-65-318-1
2	20-18985	ORAU. Gmelin, AED-CONF-65-318-2
3	20-18982	ORAU. Gmelin, AED-CONF-65-318-3
4	20-18983	ORAU. Gmelin, AED-CONF-65-318-4
5	20-18506	ORAU. Gmelin, AED-CONF-65-318-10
6	20-18984	ORAU. Gmelin, AED-CONF-65-318-7
7	20-18412	ORAU. Gmelin, AED-CONF-65-318-9
CONF-651135--	(American Physical Society, Southeastern Section, Charlottesville, Va., Nov. 1–3, 1965)	
1	20-19832	See ORNL-P-1966
CONF-651143--	(Conference on Radiobiology and Radiotherapy, Colorado Springs, Nov. 1–3, 1965)	
1	20-18507	See BNL-10009
CONF-651144--	(Symposium on Nondestructive Testing, Los Alamos, N. Mex.)	
1	20-18880	See Y-KD-5
CONF-651202--	(Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna, Dec. 6–10, 1965)	
10	20-20352	ORAU
32	20-20350	ORAU
44	20-20351	ORAU
CONF-660102--	(4th Symposium of Fundamental Phenomena in the Materials Sciences, Boston, Jan. 31, 1966)	
1	20-19218	See NYO-2394-18
CONF-660104--	(Symposium on Magnet Flat Topping for Rapid Cycling Particle Accelerators, Princeton, N. J., Jan. 31–Feb. 1, 1966)	
1	20-19303	See PPAD-581D
CONF-660105--	(3rd Conference on Symmetry Principles, Coral Gables, Jan. 19–21, 1966)	
1	20-19541	See UR-875-121
2	20-19533	See BNL-9934
CONF-660204--	(American Nuclear Society Meeting, San Diego, Calif., Feb. 7–9, 1966)	
5	20-19779	See GA-6904
6	20-19812	See GA-6919
CONF-660205--	(Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, New York, Feb. 1966)	
4	20-19181	See SC-DC-66-1297
CONF-660206--	(Symposium on Neutron Noise, Waves, and Pulse Propagation, Gainesville, Feb. 14–16, 1966)	
3	20-20295	See LA-DC-7514
CONF-660208--	(Symposium on Solidification and Long-Term Storage of Highly Radioactive Wastes, Richland, Wash., Feb. 14–18, 1966)	
10	20-18897	See ORNL-P-2006
11	20-20344	See BNL-10047
12	20-20348	See RL-SA-60
13	20-20345	See BNWL-SA-569
15	20-20347	See ORNL-P-2058
CONF-660209	(Conference on Intermediate Energy Physics, Williamsburg, Va., Feb. 9–11, 1966)	
1	20-19454	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3	20-19540	See UCRL-14647-T
CONF-660304--	(Institute of Electrical and Electronics Engineers, Scintillation and Semiconductor Counter Symposium, Washington, D. C., Mar. 2–4, 1966)	
4	20-19042	See UCRL-14445
CONF-660305--	(American Nuclear Society, Topical Meeting, Augusta, Ga., Mar. 21–23, 1966)	
15	20-18949	See SC-DC-66-1369
16	20-19134	See DUN-SA-5
17	20-19133	See DUN-SA-4
CONF-660306--	(American Physical Society, Conference on Isobaric Spin, Tallahassee, Mar. 17–19, 1966)	
1	20-19838	See UCRL-14760-T
2	20-19837	See UCRL-14750-T
3	20-19826	See MIT-2098-229
CONF-660308--	(American Nuclear Society, Plutonium Information Meeting, Washington, D. C., Mar. 1–2, 1966)	
1	20-18948	See RFP-720
2	20-20240	See LA-DC-7739

Report No.	Abstract No.	Availability
3	20-20231	See BNWL-SA-547
CONF-660311–	**(Symposium on Water Production Using Nuclear Energy, Tucson, Ariz., Mar. 30–Apr. 1, 1966)**	
1	20-20288	See BNWL-SA-596
CONF-660312–	**(Nederlands Atoomforum, Utrecht, Netherlands, Mar. 15, 1966)**	
1	20-18508	See BNL-10038
CONF-660407–	**(Spring Joint Computer Conference, Boston, Apr. 26–28, 1966)**	
1	20-19173	See UCRL-16481
2	20-19839	See UCRL-16478
CONF-660506–	**(American Inst. of Chemical Engineers, Nuclear Engineering Div. Symposium, Columbus, Ohio, May 15, 1966)**	
1	20-18626	See GA-6865
CONF-660507–	**(Symposium for the Disposal of Radioactive Wastes into Sea, Oceans, and Surface Waters, Vienna, May 17, 1966)**	
1	20-18902	See RLO-1725-41
2	20-18903	See RLO-1750-3
CONF-660508–	**(Symposium on Radiation Chemistry, Tihany, Hungary, May 16–20, 1966)**	
1	20-18724	See BNL-10012
CONF-660510–	**(International Conference on Isochronous Cyclotrons, Gatlinburg, Tenn., May 2–5, 1966)**	
1	20-20019	See UCRL-14511-T(Rev.1)
CONF-660704–	**(Magnetohydrodynamic Electrical Power Generation, 2nd International Symposium, Salzburg, July 4–8, 1966)**	
1	20-19414	See AE-214
COO–		
264-296	20-19510	Phys. Rev. Lett., 16: 595-7(1966)
587-19	20-20105	Dep. mn. CFSTI $2.00 cy, $0.50 mn
614-43	20-19171	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1044-23	20-20106	Dep. mn. CFSTI $3.00 cy, $0.50 mn
1177-18	20-18861	Dep. mn. CFSTI $6.00 cy, $1.25 mn
1177-19	20-18862	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1371-24	20-19511	Phys. Rev. Lett., 16: 598-600(1966)
CRDC–	**(Canadian)**	
1230	20-18558	See AECL-2526
CU–	**(Misc.)**	
2660-24	20-18624	ORAU
DESY–	**(German)**	
65/16	20-19024	Dep. mn
DLR-FB–	**(German)**	
64-13	20-20003	See N-65-16442
64-14	20-19423	See N-65-27044
64-27	20-19415	See N-65-16645
DP–		
834	20-20186	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1022	20-18823	Dep. mn. CFSTI $1.00 cy, $0.50 mn
DS–	**(Non-AEC)**	
64-R371-44	20-19100	See N-65-18004
DSR–	**(Non-AEC)**	
4542-39	20-18867	See NP-15897
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
DUN-SA–		
4	20-19133	Dep. mn. CFSTI $1.00 cy, $0.50 mn
5	20-19134	Dep. mn. CFSTI $1.00 cy, $0.50 mn
DVL–	**(German)**	
304	20-20003	See N-65-16442
315	20-19423	See N-65-27044
375	20-19415	See N-65-16645

Report No.	Abstract No.	Availability
ECOM–	**(Non-AEC)**	
01313-2	20-19093	See AD-629948
EFINS–	**(Misc.)**	
65-111	20-19510	See COO-264-296
EGG–		
1183-1165	20-18989	Dep. mn. CFSTI $1.00 cy, $0.50 mn
EIR–	**(Swiss)**	
86	20-19025	Dep. mn
87	20-20311	Dep. mn
EOS–	**(Non-AEC)**	
4370-Final	20-19101	See N-65-19687
5030-Final	20-19029	See N-65-16933
ER–	**(Misc.)**	
17	20-20014	See NP-15938
18	20-19328	See NP-15939
7686	20-19103	See N-65-19758
EUR–	**(European Atomic Energy Community)**	
119.e(Vol.2)	20-19810	EURATOM
2335.e	20-18863	See EURAEC-1360
2336.e	20-20187	See EURAEC-1361
2454.f	20-18560	Dep. mn
2462.f	20-18286	Dep. mn
2465.i	20-19811	Dep. mn
2521.e	20-20235	Dep. mn
2527.d	20-18803	Dep. mn
2635.d	20-18561	Dep. mn
2638.i	20-18287	Dep. mn
2640.e	20-18562	Dep. mn
2641.d,f,e	20-19296	Dep. mn
2642.f	20-18939	Dep. mn
2646.e	20-18625	Dep. mn
2647.f	20-18563	Dep. mn
2648.f	20-19204	Dep. mn
2685	20-18824	See EURAEC-1536
2700	20-20236	See EURAEC-1561
2734.e	20-20107	Dep. mn
2747.f	20-18940	Dep. mn
2748.e	20-18564	Dep. mn
2749.e	20-19255	Dep. mn
2751.e	20-20203	Dep. mn
EURAEC–		
1360	20-18863	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1361	20-20187	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1480	20-18869	See NYO-3114-10
1534	20-20271	See WCAP-3385-6
1536	20-18824	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1561	20-20236	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1585	20-18864	See GEAP-4935
1586	20-19205	See GA-6923
1588	20-19188	See GEAP-5001
1591	20-19187	See BMI-1760
1592	20-19253	See CEND-3107-261
EURFNR–	**(Misc.)**	
42F	20-20237	Dep. mn. CFSTI $7.00 cy, $1.75 mn
FFN–	**(Swedish)**	
5	20-19791	Nucl. Instrum. Methods, 40: 291-304(1966)
FIS–	**(South African)**	
15	20-19831	See NP-15912
FR–	**(Non-AEC)**	
65-10-252	20-19093	See AD-629948
FSD-ING–	**(Canadian)**	
33	20-19272	See AECL-2531
GA–	**(Misc.)**	
6824	20-19778	Dep. mn. CFSTI $5.00 cy, $1.25 mn
6829	20-20238	Dep. mn. CFSTI $1.00 cy, $0.50 mn
6865	20-18626	Dep. mn. CFSTI $1.00 cy, $0.50 mn
6904	20-19779	Dep. mn. CFSTI $2.00 cy, $0.50 mn
6919	20-19812	Dep. mn. CFSTI $2.00 cy, $0.50 mn
6923	20-19205	Dep. mn. CFSTI $1.00 cy, $0.50 mn

Report No.
GACD–
3760
3825
3960
4008
4457
4508
5716
5974
6009
6249
GE-TM–
65-2-15
65-9-14
GEAP–
4935
5001
GES–
23-467
GLR–
41
HDL-PR–
64-1
HPR–
65
IAE–
973
IBJ–
See INR
IC–
66/12
66/19
66/23
66/25
66/26
66/27
IDO–
12047
17060
17154
IFJ–
See INP
IFK–
14
15
IITRI–
578P21-17
T6042-17
U-6028-19
INP–
440/PL
441/PL
INR–
656/IX-A/
657/II/PL
661/IA/PI
INSJ–
94
95
IPP–
1/44
2/43
3/36
IS–
1008

Report No.	Abstract No.	Availability
GACD-	(Non-AEC)	
3760	20-19207	See N-65-21346
3825	20-19208	See N-65-21347
3960	20-19209	See N-65-21348
4008	20-19210	See N-65-21349
4457	20-19211	See N-65-21350
4508	20-19212	See N-65-21351
5716	20-20006	See N-65-19896
5974	20-19108	See N-65-21459
6009	20-20005	See N-65-19889
6249	20-19110	See N-65-21762
GE-TM-		
65-2-15	20-20185	See CONF-650204-9
65-9-14	20-18577	See TID-22670
GEAP-	(Misc.)	
4935	20-18864	Dep. mn. CFSTI $3.00 cy, $0.50 mn
5001	20-19188	Dep. mn. CFSTI $3.00 cy, $0.75 mn
GES-	(Non-AEC)	
23-467	20-19416	See N-65-17881
GLR-		
41	20-18870	See SAN-409-28
HDL-PR-	(Non-AEC)	
64-1	20-19096	See N-65-17884
HPR-	(Norwegian)	
65	20-20289	Dep. mn
IAE-	(Non-AEC)	
973	20-19297	Dep. mn
IBJ-	(Polish)	
See INR		
IC-	(Misc.)	
66/12	20-19172	Dep. mn
66/19	20-19534	Dep. mn
66/23	20-19535	Dep. mn
66/25	20-19536	Dep. mn
66/26	20-19537	Dep. mn
66/27	20-19538	Dep. mn
IDO-		
12047	20-18941	Dep. mn. CFSTI $2.00 cy, $0.50 mn
17060	20-20312	Dep. mn. CFSTI $7.40 cy, $2.00 mn
17154	20-19178	Dep. mn. CFSTI $4.00 cy, $1.00 mn
IFJ-	(Polish)	
See INP		
IFK-	(German)	
14	20-19813	Dep. mn
15	20-19814	Dep. mn
IITRI-	(Misc.)	
578P21-17	20-20188	CFSTI $1.00 cy, $0.50 mn
T6042-17	20-20188	See IITRI-578P21-17
U-6028-19	20-20105	See COO-587-19
INP-	(Polish)	
440/PL	20-19815	Dep.
441/PL	20-19816	Dep.
INR-	(Non-AEC)	
656/IX-A/R	20-20204	Dep.
657/II/PL	20-19094	Dep.
661/IA/PL	20-19817	Dep.
INSJ-	(Japanese)	
94	20-19026	Dep. mn
95	20-19818	Dep. mn
IPP-	(Non-AEC)	
1/44	20-19999	Dep. mn
2/43	20-20000	Dep. mn
3/36	20-20001	Dep. mn
IS-		
1008	20-18678	J. Inorg. Nucl. Chem., 28: 377-80(1966)
1225	20-20357	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1236	20-18599	J. Chromatogr., 21: 460-70(1966)
IS-T-		
45	20-19819	Dep. mn. CFSTI $2.00 cy, $0.50 mn
64	20-19357	Dep. mn. CFSTI $5.00 cy, $1.00 mn
73	20-18725	Dep. mn. CFSTI $3.00 cy, $0.75 mn
74	20-18726	Dep. mn. CFSTI $2.00 cy, $0.50 mn
78	20-19820	Dep. mn. CFSTI $3.00 cy, $0.75 mn
JAERI-	(Japanese)	
1094	20-19780	Dep. mn
1095	20-19781	Dep. mn
1097	20-20205	Dep. mn
1100	20-18727	Dep. mn
5014	20-20358	Dep. mn
JINR-	(Russian)	
E-2544	20-19539	Dep. mn
E-2560	20-19441	Dep. mn
E-2561	20-19821	Dep. mn
E-2609	20-19442	Dep. mn
E-2614	20-19443	Dep. mn
P-2281	20-19298	Dep. mn
P-2301	20-19822	Dep. mn
P-2431	20-19823	Dep. mn
P-2540	20-19824	Dep. mn
JPL-TR-	(Non-AEC)	
32-808	20-20293	
K-C-		
718	20-19135	Dep. mn. CFSTI $2.00 cy, $0.50 mn
KFK-	(German)	
365	20-18825	Dep. mn
KFK-tr-	(German)	
177	20-18637	Dep. mn. JCL $1.60 fs, $0.80 mf
LA-		
3374	20-19782	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3418	20-18865	Dep. mn. CFSTI $3.00 cy, $0.75 mn
3425	20-18866	Dep. mn. CFSTI $4.00 cy, $1.00 mn
3432	20-18288	Dep. mn. CFSTI $6.00 cy, $1.50 mn
3442	20-20002	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3446	20-20294	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3451	20-18990	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3465	20-18565	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3469	20-18566	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3471	20-20108	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3482	20-20239	Dep. mn. CFSTI $3.00 cy, $0.75 mn
LA-DC-		
7514	20-20295	ORAU
7717	20-19350	Phys. Rev. Lett., 16: 631-3(1966)
7739	20-20240	Dep. mn. CFSTI $1.00 cy, $0.50 mn
7763	20-20156	Phys. Rev. Lett., 16: 616-18(1966)
LAL-	(French)	
1153	20-19825	Dep. mn
LNF-	(Italian)	
65/38	20-18889	Dep. mn
65/43	20-18991	Dep. mn
65/46	20-18992	Dep. mn
LYCEN-	(French)	
6537	20-19444	Dep. mn
MAB-	(Non-AEC)	
217-M	20-18567	CFSTI
MIT-	(Misc.)	
2098-218	20-19573	Phys. Lett., 20: 518-21(1966)
2098-229	20-19826	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3031-3	20-20109	Dep. mn. CFSTI $1.00 cy, $0.50 mn
ML-	(Misc.)	
1294	20-20007	See N-65-22196

Report No.	Abstract No.	Availability
MURA–	**(Misc.)**	
707	20-19299	Dep. mn. CFSTI $1.00 cy, $0.50 mn
N–	**(Misc.)**	
65-16347	20-19095	CFSTI $1.00 cy, $0.50 mn
65-16442	20-20003	ZLDI, Munich 13 DM
65-16483	20-18290	CFSTI $1.00 cy, $0.50 mn
65-16489	20-20004	CFSTI $4.00 cy, $0.75 mn
65-16497	20-18187	CFSTI $5.00 cy, $1.00 mn
65-16588	20-19027	CFSTI $1.00 cy, $0.50 mn
65-16645	20-19415	ZLDI, Munich 6,70 DM
65-16742	20-18881	CFSTI $4.00 cy, $1.00 mn
65-16815	20-18206	CFSTI $2.00 cy, $0.50 mn
65-16830	20-19274	CFSTI $2.00 cy, $0.50 mn
65-16844	20-19028	
65-16890	20-18882	CFSTI $1.00 cy, $0.50 mn
65-16933	20-19029	CFSTI $3.00 cy, $0.50 mn
65-17058	20-18291	CFSTI $1.00 cy, $0.50 mn
65-17068	20-18292	CFSTI $1.00 cy, $0.50 mn
65-17099	20-19722	CFSTI $1.00 cy, $0.50 mn
65-17115	20-18942	CFSTI $2.00 cy, $0.50 mn
65-17255	20-19358	CFSTI $2.00 cy, $0.50 mn
65-17266	20-19030	CFSTI $3.00 cy, $0.75 mn
65-17282	20-19613	CFSTI $1.00 cy, $0.50 mn
65-17283	20-19614	CFSTI $1.00 cy, $0.50 mn
65-17331	20-19206	CFSTI $1.00 cy, $0.50 mn
65-17508	20-19723	CFSTI $2.00 cy, $0.50 mn
65-17881	20-19416	CFSTI $2.00 cy, $0.50 mn
65-17884	20-19096	CFSTI $3.00 cy, $0.50 mn
65-17886	20-19097	CFSTI $3.00 cy, $0.75 mn
65-17953	20-19098	CFSTI $1.00 cy, $0.50 mn
65-17954	20-19099	CFSTI $1.00 cy, $0.50 mn
65-18004	20-19100	
65-19687	20-19101	CFSTI $3.00 cy, $0.75 mn
65-19693	20-19102	CFSTI $2.00 cy, $0.50 mn
65-19758	20-19103	CFSTI $3.00 cy, $0.75 mn
65-19766	20-19031	CFSTI $1.00 cy, $0.50 mn
65-19867	20-19104	CFSTI $1.00 cy, $0.50 mn
65-19870	20-19105	CFSTI $2.00 cy, $0.50 mn
65-19886	20-19106	CFSTI $2.00 cy, $0.50 mn
65-19888	20-19615	CFSTI $5.00 cy, $1.00 mn
65-19889	20-20005	CFSTI $1.00 cy, $0.50 mn
65-19896	20-20006	CFSTI $1.00 cy, $0.50 mn
65-21161	20-19189	CFSTI $4.00 cy, $0.75 mn
65-21263	20-19107	
65-21300	20-19324	CFSTI $3.00 cy, $0.75 mn
65-21332	20-19640	CFSTI $1.00 cy, $0.50 mn
65-21346	20-19207	CFSTI $1.00 cy, $0.50 mn
65-21347	20-19208	CFSTI $1.00 cy, $0.50 mn
65-21348	20-19209	CFSTI $1.00 cy, $0.50 mn
65-21349	20-19210	CFSTI $1.00 cy, $0.50 mn
65-21350	20-19211	CFSTI $1.00 cy, $0.50 mn
65-21351	20-19212	CFSTI $1.00 cy, $0.50 mn
65-21422	20-18426	CFSTI $1.00 cy, $0.50 mn
65-21432	20-18883	CFSTI $3.00 cy, $0.75 mn
65-21459	20-19108	CFSTI $1.00 cy, $0.50 mn
65-21462	20-20296	CFSTI $5.00 cy, $1.00 mn
65-21643	20-19179	CFSTI $2.00 cy, $0.50 mn
65-21644	20-19827	CFSTI $2.00 cy, $0.50 mn
65-21724	20-18943	CFSTI $1.00 cy, $0.50 mn
65-21739	20-19213	CFSTI $1.00 cy, $0.50 mn
65-21743	20-19109	
65-21748	20-19641	
65-21762	20-19110	CFSTI $1.00 cy, $0.50 mn
65-21774	20-19417	CFSTI $2.00 cy, $0.50 mn
65-22097	20-19214	
65-22107	20-19198	
65-22126	20-19828	CFSTI $1.00 cy, $0.50 mn
65-22168	20-19190	CFSTI $1.00 cy, $0.50 mn
65-22196	20-20007	CFSTI $2.00 cy, $0.50 mn
65-22329	20-20008	
65-22617	20-20009	
65-22651	20-19325	CFSTI $2.00 cy, $0.50 mn
65-22654	20-18923	
65-22849	20-20093	CFSTI $4.00 cy, $1.00 mn
65-22973	20-19418	CFSTI $2.00 cy, $0.50 mn
65-22975	20-18884	CFSTI $4.00 cy, $1.00 mn
65-23065	20-19300	CFSTI $2.00 cy, $0.50 mn
65-23066	20-19642	CFSTI $2.00 cy, $0.50 mn
65-23194	20-19326	
65-23211	20-20010	CFSTI $2.00 cy, $0.50 mn
65-23253	20-18885	CFSTI $2.00 cy, $0.50 mn
65-23662	20-19643	CFSTI $1.00 cy, $0.50 mn
65-23928	20-19032	CFSTI $1.00 cy, $0.50 mn
65-23933	20-19644	CFSTI $1.00 cy, $0.50 mn
65-24356	20-18993	CFSTI $1.00 cy, $0.50 mn
65-24388	20-19359	CFSTI $2.00 cy, $0.50 mn
65-24571	20-19132	CFSTI $1.00 cy, $0.50 mn
65-24874	20-19419	CFSTI $6.00 cy, $1.50 mn
65-25265	20-20011	CFSTI $5.00 cy, $1.50 mn
65-25271	20-19420	CFSTI $6.00 cy, $1.50 mn
65-25286	20-19724	
65-25406	20-19421	CFSTI $2.00 cy, $0.50 mn
65-25549	20-18886	CFSTI $1.00 cy, $0.50 mn
65-26400	20-19033	CFSTI $4.00 cy, $1.00 mn
65-26627	20-18851	CFSTI $3.00 cy, $0.50 mn
65-26628	20-19422	CFSTI $2.00 cy, $0.50 mn
65-27044	20-19423	ZLDI, Munich 9,20 DM
65-27121	20-19616	
65-27393	20-19617	CFSTI $1.00 cy, $0.50 mn
65-27406	20-19327	
65-27813	20-20012	CFSTI $1.00 cy, $0.50 mn
65-27827	20-19034	CFSTI $5.00 cy, $1.00 mn
NAA-SR–		
10951	20-19783	Dep. mn. CFSTI $2.45 cy, $0.75 mn
11193	20-20297	Dep. mn. CFSTI $2.00 cy, $0.50 mn
11356	20-20206	CFSTI $4.00 cy, $1.00 mn
11530	20-19784	Dep. mn. CFSTI $3.00 cy, $0.75 mn
11762	20-20298	Dep. mn. CFSTI $2.00 cy, $0.50 mn
NASA-CR–	**(Misc.)**	
41	20-19030	See N-65-17266
217	20-19189	See N-65-21161
50286	20-19613	See N-65-17282
50292	20-19614	See N-65-17283
50546	20-18291	See N-65-17058
51513	20-19028	See N-65-16844
51826	20-18290	See N-65-16483
52231	20-18292	See N-65-17068
52405	20-20004	See N-65-16489
53213	20-19274	See N-65-16830
54129	20-19358	See N-65-17255
54147	20-20009	See N-65-22617
54148	20-18884	See N-65-22975
54211	20-18881	See N-65-16742
54217	20-18883	See N-65-21432
54272	20-19416	See N-65-17881
54401	20-18851	See N-65-26627
54406	20-19359	See N-65-24388
54421	20-19422	See N-65-26628
56214	20-18187	See N-65-16497
57287	20-19101	See N-65-19687
57297	20-19102	See N-65-19693
57300	20-19031	See N-65-19766
57352	20-19103	See N-65-19758
57433	20-19615	See N-65-19888
57434	20-20005	See N-65-19889
57437	20-20006	See N-65-19896
57471	20-19104	See N-65-19867
57478	20-19105	See N-65-19870
57505	20-19106	See N-65-19886
57895	20-19209	See N-65-21348
57896	20-19212	See N-65-21351
57897	20-19208	See N-65-21347
57898	20-19210	See N-65-21349
57899	20-19207	See N-65-21346
57900	20-19211	See N-65-21350
57944	20-19640	See N-65-21332
57992	20-19324	See N-65-21300
60706	20-19029	See N-65-16933
60709	20-18206	See N-65-16815
60717	20-19722	See N-65-17099
60873	20-19723	See N-65-17508
60938	20-19096	See N-65-17884
60944	20-19097	See N-65-17886
60983	20-19099	See N-65-17954
60984	20-19098	See N-65-17953
61046	20-19418	See N-65-22973
61055	20-19132	See N-65-24571
62131	20-20007	See N-65-22196
62133	20-18426	See N-65-21422
62187	20-20296	See N-65-21462
62191	20-19108	See N-65-21459

Report No.
62198
62229
62241
62339
62343
62456
62470
62521
62576
62588
62663
62743
62753
62873
62976
62977
63162
63184
63394
63743

NASA-SP–
97
5037

NASA-TM–
X-1105
X-54990
X-55211

NASA-TN–
D-2608
D-2653
D-2670
D-2673
D-2757
D-2768
D-2774
D-2781
D-2892
D-2912
D-3332
D-3344
D-3345
D-3361
D-3379

NBL–
230

NBS–
7616
7684

NE–
3

NEIC-RR–
20

NIJS-R–
454
455
458
459
460
467
470
473

NIRL-R–
44

NLCO–
954

NP–
14898
15055
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Report No.	Abstract No.	Availability
62198	20-18943	See N-65-21724
62229	20-19417	See N-65-21774
62241	20-19110	See N-65-21762
62339	20-19828	See N-65-22126
62343	20-19190	See N-65-22168
62456	20-20093	See N-65-22849
62470	20-19300	See N-65-23065
62521	20-19326	See N-65-23194
62576	20-19642	See N-65-23066
62588	20-20010	See N-65-23211
62663	20-19643	See N-65-23662
62743	20-19032	See N-65-23928
62753	20-19644	See N-65-23933
62873	20-18993	See N-65-24356
62976	20-19420	See N-65-25271
62977	20-19419	See N-65-24874
63162	20-20011	See N-65-25265
63184	20-19421	See N-65-25406
63394	20-19033	See N-65-26400
63743	20-19034	See N-65-27827
NASA-SP–	**(Misc.)**	
97	20-19645	GPO $0.50
5037	20-19215	CFSTI $1.00 cy, $0.50 mn
NASA-TM–	**(Misc.)**	
X-1105	20-18886	See N-65-25549
X-54990	20-19095	See N-65-16347
X-55211	20-19325	See N-65-22651
NASA-TN–	**(Misc.)**	
D-2608	20-18942	See N-65-17115
D-2653	20-18882	See N-65-16890
D-2670	20-19206	See N-65-17331
D-2673	20-19027	See N-65-16588
D-2757	20-19179	See N-65-21643
D-2768	20-19213	See N-65-21739
D-2774	20-18885	See N-65-23253
D-2781	20-19827	See N-65-21644
D-2892	20-20012	See N-65-27813
D-2912	20-19617	See N-65-27393
D-3332	20-18887	CFSTI $1.60 cy, $1.00 mn
D-3344	20-19725	CFSTI $0.40 cy, $0.50 mn
D-3345	20-19424	CFSTI $0.75 cy, $0.50 mn
D-3361	20-20013	CFSTI $0.35 cy, $0.50 mn
D-3379	20-20110	CFSTI $0.15 cy, $0.50 mn
NBL–	**(Misc.)**	
230	20-18568	Dep. mn. CFSTI $3.00 cy, $0.75 mn
NBS–	**(Misc.)**	
7616	20-19613	See N-65-17282
7684	20-19614	See N-65-17283
NE–	**(Misc.)**	
3	20-20209	See TID-22730
NEIC-RR–	**(Polish)**	
20	20-19445	Dep.
NIJS-R–	**(Yugoslavian)**	
454	20-18243	Dep. mn
455	20-19829	Dep. mn
458	20-18728	Dep. mn
459	20-18627	Dep. mn
460	20-18628	Dep. mn
467	20-18244	Dep. mn
470	20-19035	Dep. mn
473	20-18207	Dep. mn
NIRL-R–	**(British)**	
44	20-19301	Dep. mn. BIS $6.00. HMSO 30s. 0d.
NLCO–		
954	20-19180	Dep. mn. CFSTI $3.00 cy, $0.75 mn
NP–	**(AEC File No. for Non-AEC Reports)**	
14898	20-18293	Dep. mn
15055	20-19830	Dep. mn
15353	20-18629	Dep. mn
15766	20-19036	Dep. mn
15796	20-19302	Dep. mn
15887	20-18569	Dep. mn
15888	20-19216	NBS Free
15896	20-18630	NBS Free
15897	20-18867	
15903	20-20299	
15904	20-20300	
15906	20-20301	
15910	20-19111	
15912	20-19831	Dep. mn
15920	20-20290	Dep. mn
15926	20-20094	CFSTI $2.00 cy, $0.50 mn
15931	20-19698	Dep.
15932	20-19446	Dep.
15933	20-19217	
15938	20-20014	Dep. mn
15939	20-19328	Dep. mn
15940	20-20015	Dep. mn
NRC–	**(Canadian)**	
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8781	20-18643	Can. J. Chem., 44: 487-94(1966)
8807	20-18734	Can. J. Chem., 44: 527-8(1966)
NSAM–	**(Non-AEC)**	
914	20-18943	See N-65-21724
NYO–		
901-35	20-18318	Cancer Res., 26: 427-34(1966)
1669-11	20-18924	Dep. mn. CFSTI $5.00 cy, $1.00 mn
2007-9	20-18729	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2024-9	20-19256	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2262-89	20-19557	J. Math. Phys., 7: 583(1966)
2266-1	20-18631	Dep. mn. CFSTI $3.00 cy, $0.75 mn
2394-18	20-19218	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2471-12	20-20111	Dep. mn. CFSTI $4.00 cy, $0.75 mn
2581-1	20-20112	Dep. mn. CFSTI $3.00 cy, $0.75 mn
2757-5	20-18570	Dep. mn. CFSTI $3.00 cy, $0.75 mn
2813-35	20-20016	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2813-36	20-20017	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2930-5	20-18868	Dep. mn. CFSTI $3.00 cy, $0.50 mn
2973-1	20-20359	Dep. mn. CFSTI $5.00 cy, $1.00 mn
3001-1	20-20113	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3114-10	20-18869	Dep. mn. CFSTI $4.00 cy, $0.75 mn
3122-35	20-20241	Dep. mn. CFSTI $4.00 cy, $0.75 mn
3379-3	20-20242	Dep. mn. CFSTI $5.00 cy, $1.25 mn
3421-6	20-19037	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3450-1	20-18199	Dep. mn. CFSTI $7.00 cy, $1.75 mn
3558-1	20-18750	J. Chem. Phys., 44: 2345-8(1966)
10742	20-19038	Dep. mn. CFSTI $6.00 cy, $1.25 mn
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3805	20-20095	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3824	20-20346	Dep. mn. CFSTI $4.00 cy, $0.75 mn
3844	20-20096	Dep. mn. CFSTI $4.00 cy, $1.00 mn
3920	20-18427	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3935	20-20114	Dep. mn. CFSTI $3.00 cy, $0.75 mn
ORNL-IIC–		
6	20-19116	Dep. mn. CFSTI $3.00 cy, $0.75 mn
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7	20-20243	Dep. ORNL Free
14	20-18945	Dep. ORNL Free
ORNL-P–	**(Misc.)**	
805	20-18651	Health Phys., 12: 521-4(1966)
1160	20-18347	Mutat. Res., 3: 3-12(1966)
1236	20-18304	Amer. J. Physiol., 210: 563-8(1966)
1355	20-18348	Mutat. Res., 3: 13-24(1966)
1408	20-18349	Mutat. Res., 3: 25-33(1966)
1597	20-18958	J. Nucl. Med., 7: 23-31(1966)
1624	20-18368	Proc. Natl. Acad. Sci. U. S., 54: 1552-7 (1965)
1625	20-19070	Nucl. Instrum. Methods, 40: 204-8(1966)
1708	20-18390	Radiat. Bot., 6: 145-50(1966)
1749	20-18754	J. Chem. Phys., 44: 2715-18(1966)
1886	20-19012	Phys. Lett., 20: 269-71(1966)
1966	20-19832	Dep. mn. CFSTI $2.00 cy, $0.50 mn
2006	20-18897	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2058	20-20347	Dep. mn. CFSTI $1.00 cy, $0.50 mn
ORNL-RSIC–		

Report No.	Abstract No.	Availability
10	20-20097	Dep. ORNL Free
12(Vol.1)	20-20098	ORNL Free
14	20-20099	Dep. ORNL Free
ORNL-TM-		
1302	20-20207	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1356(Suppl.1)	20-19117	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1358	20-20220	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1409	20-18557	Dep. mn. CFSTI $5.00 cy, $1.00 mn
1419	20-20244	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1420	20-18571	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1422	20-20115	Dep. mn. CFSTI $5.00 cy, $1.00 mn
1423	20-20100	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1428	20-18946	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1430	20-19191	Dep. mn. CFSTI $2.00 cy, $0.50 mn
ORNL-tr-		
985	20-20273	Dep. mn. JCL $8.60 fs, $3.20 mf
988	20-20274	Dep. mn. JCL $4.60 fs, $1.43 mf
ORO-		
635	20-18188	Dep. mn. CFSTI $5.00 cy, $1.00 mn
PAN-	(Polish)	(This series of reports was terminated in 1965. Subsequent reports are identified by the code INR.)
PATENTS	(Canadian)	
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1964-1639	20-19320	
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1964-2523	20-18797	
1964-3076	20-20193	
1964-3077	20-20194	
1964-3078	20-19322	
1964-3079	20-19323	
1964-3080	20-18858	
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1964-3719	20-18799	
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3,233,248	20-18986	
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3,234,412	20-20286	
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PG-Report-	(British)	
486	20-19242	Trans. Faraday Soc., 61: 2442-6(1965)
690	20-18572	Dep. BIS $0.25. HMSO 1s. 2d.
PPAD-		
581D	20-19303	Dep. mn. CFSTI $1.00 cy, $0.50 mn
2137-557	20-19889	Nucl. Instrum. Methods, 38: 319-22(1965)
2137-558	20-19002	Nucl. Instrum. Methods, 38: 19-22(1965)
2137-559	20-19888	Nucl. Instrum. Methods, 38: 299-302(1965)
PR-	(Non-AEC)	
10	20-20015	See NP-15940
PRNC-		
73	20-20360	Dep. mn. CFSTI $6.00 cy, $1.25 mn

Report No.	Abstract No.	Availability
R-	(Misc.)	
442	20-20094	See NP-15926
2357	20-18824	See EURAEC-1536
64CAP10	20-20189	Dep. mn
64CAP59	20-20308	See AECL-2544
65CAP17	20-20309	See AECL-2545
RAD-TR-	(Non-AEC)	
64-12	20-19327	See N-65-27406
RE-	(Non-AEC)	
194	20-19724	See N-65-25286
RFP-		
343	20-18947	Dep. mn. CFSTI $1.00 cy, $0.50 mn
691	20-19219	Dep. mn. CFSTI $2.00 cy, $0.50 mn
720	20-18948	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RISO-	(Danish)	
118	20-19785	Dep. mn
120	20-18573	Dep. mn
RISO-M-	(Danish)	
233	20-19039	Dep. mn
241	20-20245	Dep. mn
312	20-20246	Dep. mn
RL-SA-		
60	20-20348	Dep. mn. CFSTI $3.00 cy, $0.75 mn
RLO-		
1725-41	20-18902	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1750-3	20-18903	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RM-	(Misc.)	
4490-NASA	20-19326	See N-65-23194
4907-PR	20-19202	See AD-629571
4942(RAND)	20-18927	
RRL-		
2310-159	20-18771	J. Phys. Chem., 70: 910-24(1966)
RS-		
482	20-18853	See SWRI-1228-8-20
RT-EL-	(Italian)	
(65)9	20-19199	Dep. mn
RT-FI-	(Italian)	
(65)48	20-19833	Dep. mn
(65)51	20-20208	Dep. mn
(65)52	20-20190	Dep. mn
RT-ING-	(Italian)	
(65)18	20-20313	Dep. mn
RT-MET-	(Italian)	
(65)2	20-19220	Dep. mn
SAN-		
409-28	20-18870	Dep. mn. CFSTI $4.00 cy, $0.75 mn
SC-DC-		
65-1701	20-19646	Dep. mn. CFSTI $3.00 cy, $0.75 mn
65-1918	20-19192	Dep. mn. CFSTI $3.00 cy, $0.75 mn
66-1297	20-19181	Dep. mn. CFSTI $2.00 cy, $0.50 mn
66-1369	20-18949	Dep. mn. CFSTI $1.00 cy, $0.50 mn
SC-RR-		
65-369	20-19618	Dep. mn. CFSTI $1.00 cy, $0.50 mn
65-472	20-20302	Dep. mn. CFSTI $3.00 cy, $0.50 mn
66-41	20-20361	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SCL-DC-		
65-112	20-20362	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SCL-DR-		
65-144	20-18852	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SEL-	(Misc.)	
64-043	20-19641	See N-65-21748
SGAE-BL-	(Austrian)	

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Report No.
16/1965
SGAE-CH-
24/1965
SGAE-PH-
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21670
21975
22495
22552
22660
22670
22694
22707
22715
22716
22717
22725
22730
22738
22739

Report No.	Abstract No.	Availability
16/1965	20-18245	Dep. mn
SGAE-CH–	**(Austrian)**	
24/1965	20-19834	Dep. mn
SGAE-PH–	**(Austrian)**	
31/1965	20-18994	Dep. mn
33/1965	20-19040	
35/1965	20-19835	
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SID–	**(Non-AEC)**	
65-79-2	20-18426	See N-65-21422
SIT–	**(Misc.)**	
179	20-20016	See NYO-2813-35
180	20-20017	See NYO-2813-36
SLAC–		
55	20-19304	Dep. mn. CFSTI $2.00 cy, $0.50 mn
57	20-19041	Dep. mn. CFSTI $3.00 cy, $0.75 mn
SM–	**(Misc.)**	
44042	20-20301	See NP-15906
46285	20-20299	See NP-15903
46491	20-20300	See NP-15904
SORIN–	**(Italian)**	
34	20-18804	Dep. mn
SR–	**(Misc.)**	
4	20-19300	See N-65-23065
SRIA–		
106-37	20-18634	Dep. mn. CFSTI $1.00 cy, $0.50 mn
STI-DOC–	**(International Atomic Energy Agency)**	
56(Vol.1)	20-20314	Dep. mn. IAEA
56(Vol.2)	20-20315	Dep. mn. IAEA
STI-PUB–	**(International Atomic Energy Agency)**	
107	20-18635	IAEA: $9.00; $189,-; £3.14.0; F Fr. 36,-; DM 31,50
STL–	**(Misc.)**	
372-14(1)	20-18871	Dep. mn. CFSTI $5.00 cy, $1.00 mn
372-27	20-20178	Dep. mn. CFSTI $2.00 cy, $0.50 mn
4137-6018-SU-000	20-20009	See N-65-22617
4161-6004-KU-000	20-19105	See N-65-19870
8494-6007-SU-000(App.D)	20-19644	See N-65-23933
SWRI–		
1228-8-20	20-18853	Dep. mn. CFSTI $2.00 cy, $0.50 mn
SZS–	**(German)**	
11(1965)	20-18428	Dep. mn
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TH–	**(Non-AEC)**	
99	20-19616	See N-65-27121
TID–		
4100(Suppl.32)	20-18854	Dep. DTI Extension Free
7015(Indexes) (Rev.3)	20-18575	Dep. mn. CFSTI $1.75 cy, $1.00 mn
7015(Suppl.8)	20-18574	Dep. CFSTI $4.00 cy, $1.50 mn
21670	20-19221	Dep. mn. CFSTI $1.00 cy, $0.50 mn
21975	20-18389	Radiat. Bot., 6: 129-44(1966)
22495	20-18278	Radiology, 86: 457-62(1966)
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22660	20-18576	Dep. mn. CFSTI $3.00 cy, $0.75 mn
22670	20-18577	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22694	20-20247	ORAU
22707	20-20248	Dep. mn. CFSTI $3.00 cy, $0.75 mn
22715	20-18208	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22716	20-19257	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22717	20-18209	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22725	20-18636	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22730	20-20209	Dep. mn. CFSTI $5.00 cy, $1.00 mn
22738	20-20249	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22739	20-20250	Dep. mn. CFSTI $3.00 cy, $0.75 mn
22740	20-20251	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22741	20-20252	Dep. mn. CFSTI $2.00 cy, $0.50 mn
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22744	20-20255	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22745	20-20256	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22746	20-20257	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22748	20-20258	Dep. mn. CFSTI $2.00 cy, $0.50 mn
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22754	20-20261	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22755	20-20262	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22758	20-20263	Dep. mn. CFSTI $1.00 cy, $0.50 mn
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22766	20-18294	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22768	20-20265	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22770	20-20266	Dep. mn. CFSTI $1.00 cy, $0.50 mn
22772	20-19305	Dep. mn. CFSTI $2.00 cy, $0.50 mn
22785	20-20018	Dep. mn. CFSTI $1.00 cy, $0.50 mn
TR–	**(Misc.)**	
11	20-20008	See N-65-22329
3408-2	20-19641	See N-65-21748
TRG–	**(Misc.)**	
136-FR	20-20093	See N-65-22849
TRG-Report–	**(British)**	
954	20-19222	Dep. BIS $0.80. HMSO 4s.
1165	20-18578	Dep. BIS $0.50. HMSO 2s. 6d.
TRW-ER–	**(Misc.)**	
6291	20-18884	See N-65-22975
UCB–	**(Misc.)**	
34P64-1	20-18873	Dep. mn. CFSTI $5.00 cy, $1.00 mn
UCLA–		
12-576	20-18189	Dep. mn. CFSTI $4.00 cy, $0.75 mn
UCOL–	**(Misc.)**	
535-549	20-19162	Nucl. Instrum. Methods, 38: 133-9(1965)
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14511-T(Rev.1)	20-20019	Dep. mn. CFSTI $1.00 cy, $0.50 mn
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14605	20-19921	Phys. Lett., 20: 410-12(1966)
14614-T	20-19447	Dep. mn. CFSTI $3.00 cy, $0.75 mn
14643-T	20-19699	Dep. mn. CFSTI $1.00 cy, $0.50 mn
14647-T	20-19540	Dep. mn. CFSTI $2.00 cy, $0.50 mn
14750-T	20-19837	Dep. mn. CFSTI $1.00 cy, $0.50 mn
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